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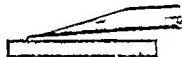
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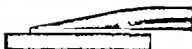
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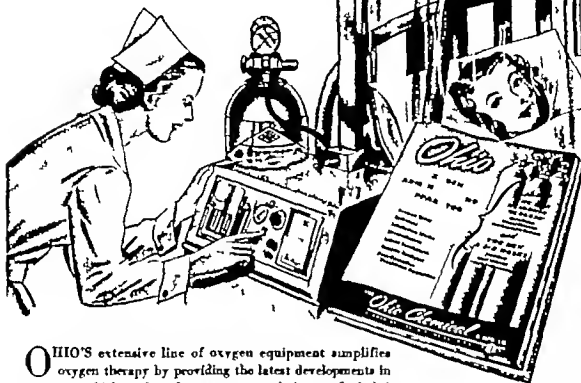
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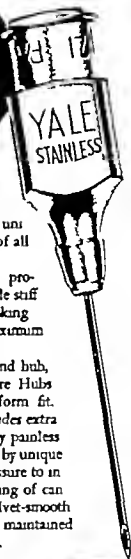


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
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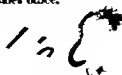
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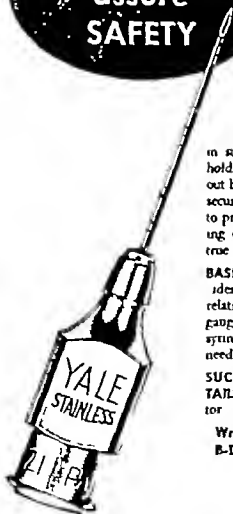
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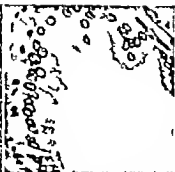


Fig. 2



Fig. 3



Fig. 4

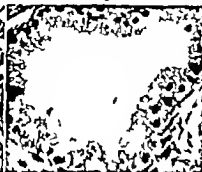


Fig. 5



Fig. 6

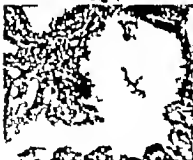


Fig. 7



Fig. 8

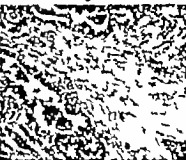


Fig. 9

*Apocrine Tissue Chronic Cystic Mastitis and Sweat Gland Carcinoma of the Breast.*

—John F. Higginson and John R. McDonald

(Legends on opposite page.)

# SURGERY

## GYNECOLOGY AND OBSTETRICS

VOLUME 88

JANUARY, 1949

NUMBER 1

### APOCRINE TISSUE, CHRONIC CYSTIC MASTITIS AND SWEAT GLAND CARCINOMA OF THE BREAST

JOHN F HIGGINSON M.D. and JOHN R McDONALD M.D., Rochester Minnesota

SINCE "pale epithelium" was first described, it has been the object of numerous pathologic and experimental studies. It has been considered variously as evidence of degeneration, carcinoma, atavism, metaplasia, heteroplasia and alloplasia, a variant of normal breast tissue, sweat gland tissue, and finally, and most important, apocrine skin gland tissue.

It has been found by some workers in the periphery of the normal breast and by fewer

Abridgment of thesis submitted by Dr. Higginson to the Faculty of the Graduate School of the University of Minnesota in partial fulfillment of the requirements for the degree of Master of Science in Surgery.

From the Division of Surgery, Mayo Foundation, and the Section on Surgical Pathology, Mayo Clinic.

workers in the depths of the normal breast proper. It has been related etiologically to carcinoma of the breast and especially to chronic cystic mastitis; it has also been listed as an accompaniment of these and other lesions of the breast. Many papers have been written concerning the embryology of the breast and other cutaneous glands, especially the sweat glands, which tend to show a common origin or relationship or none at all. Morphologic studies have been reported; clinical observations have been recorded; and experiments have been performed which show a relationship of "pale epithelium" in the breast to sweat glands, to various pathologic and physiologic body states, and to various hormonal imbalances.

Fig. 1. Axillary specimen of skin showing apocrine glands in secretory and resting stages. The eosinophilia is apparent. Also visible are a sebaceous gland and an eccrine (true sweat) gland. Hematoxylin and eosin, X33.

Fig. 2. Same tissue as in Figure 1. View of tall columnar epithelium which contains red-staining and brown pigment granules. Myoepithelial cells can be seen in cross section on the left and in longitudinal section above on the right. Hematoxylin and eosin, X380.

Fig. 3. Section from a breast removed for carcinoma (malignant tissue not shown here). The pale epithelium is seen in and as part of a lobule of the breast surrounded by "normal" or usual mammary tissue. No cystic change is present. Hematoxylin and eosin, X45.

Fig. 4. Section from a breast removed for extensive chronic cystic mastitis. Note cystic change in acini and papillary formation of the pale epithelium. Hematoxylin and eosin, X17.

Fig. 5. Section from a breast removed for chronic cystic mastitis. Note the eosinophilic granules and the fewer brownish granules. Hematoxylin and eosin, X235. Compare with Figure 2.

Fig. 6. Section from a breast removed for carcinoma (malignant tissue not shown here). Note brown yellow pigment granules (in unusual abundance in this section), and also a few fat droplets. Myoepithelial cells in tangential and longitudinal section. Hematoxylin and eosin, X235.

Fig. 7. Section from a breast removed for carcinoma (malignant tissue not shown here). Note direct continuity between apocrine sweat gland type of tissue ("pale epithelium") and usual or normal mammary tissue. Hematoxylin and eosin, X130.

Fig. 8. Section from a breast removed for carcinoma (malignant tissue not shown here). Pale epithelium shows hyperplasia. Enlarged, hyperchromatic nuclei contain enlarged, hyperchromatic, often multiple nucleoli. Two, three, and four nucleoli can be seen in some instances. Hematoxylin and eosin, X325.

Fig. 9. Section from a breast removed for carcinoma. Malignant cells are visible. The morphologic and especially the staining characteristics are similar to those of "pale epithelium" except for the obvious signs of malignancy. These cells look strikingly different from those in the commoner carcinoma of breast. Hematoxylin and eosin, X45.

The purpose of the study recorded herein was to attempt to establish the status of the so called pale epithelium in the breast.

The frequent finding of this tissue in routine sections of surgically resected breasts aroused curiosity concerning it and moreover the term "Schimmelbusch hyperplasia," which is used to designate this tissue was thought, and later found to be incorrect. In addition the similarity of appearance of this "pale epithelium" and the epithelium of apocrine sweat glands elsewhere in the body seemed to indicate a relationship not commonly discussed or understood.

For the purpose of this study a review of the literature was undertaken covering the embryology physiology morphology and pathology of the cutaneous glands particularly the mammary and other apocrine skin glands.

In addition 97 unselected surgically removed breasts were studied to redetermine the incidence of pale epithelium in pathologic breasts the histologic picture presented by this tissue and the degree of similarity in structure and staining reaction of this tissue to that of apocrine skin gland tissue such as is found in the axilla. For the latter comparison, postmortem specimens of axillary skin were obtained at random from 6 subjects of varying sex and age in these cases death had resulted from various illnesses but in none were there lesions of the breast. There are three types of cutaneous glands in the human being namely (1) the holocrine (sebaceous) glands, (2) the eccrine (sweat) glands, and (3) the apocrine glands. The last mentioned consist of odoriferous or accessory sex glands which are found in the axilla in the groin and genital region and in the perianal region the ceruminous glands Moll's glands and the mammary glands.

Apocrine glands are not sweat glands in any manner as we understand and use the term

in the breast of tissue resembling, or identical with, other apocrine gland tissue such as is found in the axilla.

This study confirms those of others who have remarked on the morphologic and staining similarity and lends support to the argument that there is a logical basis for the histologic appearance of certain lesions of the breast such as the much mooted so called sweat-gland carcinoma of the breast.

#### REVIEW OF LITERATURE

Robin and Horner (18-19) emphasized sharply the difference between the 2 types of sweat glands in man and working individually they noted that in the axilla these glands lay in a definitely localized group but that they also could be found in the inguinal fold. Both men noted that there seemed to be a distinct and prominent odor emitted from these glands Horner terming them the odoriferous glands, and both men observed that the glands were macroscopic and appeared to have a pink or reddish color. Schiefferdecker offered the following classification of the cutaneous glands.

- 1 Holocrine glands (sebaceous gland or hair follicle gland)

- 2 Merocrine glands

- a Merocrine-apocrine glands (large sweat glands in human beings, the glands of the hairy skin of most mammals, and the "milk glands" and "mammary glands")

- b Merocrine-eccrine glands (small sweat glands in human beings the glands in the soles of the paws of the cat and the dog in the snout of the swine, and in small numbers in the skin of some apes and so forth)

He made the point that actually the apocrine glands are not real or true cutaneous glands but an entirely special type of gland which is found in various parts of the body. In mammals these glands can and do occur in the skin and so in these animals they become cutaneous glands. In this way they fortuitously become neighbors of the eccrine glands.

between the "sweat" glands and the milk glands. Rein in 1882 noticed the earliest trace of the anlage of the breast in the human embryo of 24 millimeters (6 to 7 weeks old) and stated that he considered the Montgomery glands to be miniature copies of the mammary but at a slightly earlier stage of development. Benda (1, 2) considered the deeper portion of the Montgomery gland to be of the apocrine "sweat" gland type. Brouha in 1905 correlated the human areola with the peripheral section of the primitive mammalian gland field. Brouha and later Schiefferdecker stated that this fact easily explained the participation of the areolar glands in the secretion by the milk gland at the time of birth (with milk) and also the occasionally seen phenomenon of secretion of milk by these glands which earlier (in lower animals) were regularly employed in the nourishment of the newborn. They stated that, accordingly in human beings there can be found in the milk glands and in the areolae all gradual changes or transitions of the apocrine glands from the central large milk gland through the smaller accessory milk glands to the usual apocrine glands.

Richter found iron in all of the apocrine glands of men and animals that he examined and he considered its presence a general earmark. He stated also that these glands secrete cholesterol, an observation which had been made previously by Walter (50) in 1924.

Way and Memmesheimer agreed with Herzberg and others that the apocrine glands deserve consideration as accessory sexual glands. They stated that there seemed to be a definite relation between cellular activity and the amounts of cholesterol and hemofuscin present, and they found these substances as well as hemosiderin in their specimens.

Kölliker (21) and Talke (46, 47) were among the first to mention and describe muscular fiber cells in the sweat glands.

Sheldon in 1941 found myoepithelium present in breasts eccrine and apocrine sweat glands, Moll's glands and the ceruminous glands of the ear. Similar contractile epithelial elements called "basket" cells are found in the salivary and lacrimal glands as noted by Loeb. Kölliker (22) in 1889 described the myoepi-

thelium as forming the outer of two layers of cells within the basement membrane. This myoepithelium is considered to be ectodermal in origin (Kölliker, 22, von Eggeling, Schiefferdecker, Hamperl, Sheldon, Kuzma, and others).

In 1941 Suzuki in discussing carcinoma of the sweat glands stated that one class which he called 'carcinoma sudoripara cysticum papilliferum' should include the sweat gland adenocarcinomas of the vulva, carcinomas of apocrine glands elsewhere such as von Winkler's case (ceruminous gland) and Salzmann's case (Moll's glands) and also so called sweat gland carcinomas of the breast. Gates, Warren, and Warvi stated that the histogenetic relationship had not been established between apocrine glands and the cells of some types of carcinoma of the breast as, in their opinion all of the cutaneous appendages, including the mammary gland derive from the primitive surface epithelium independently.

In 1937 Weiner suggested that Paget's disease of the skin is the result of intraepidermal metastasis from an underlying carcinoma of apocrine sweat glands and he noted that the lesion in all cases of extramammary Paget's disease occurs in sites where apocrine glands are found and that mammary glands are also modified apocrine glands.

Krompecher (24) expressed the thought that small cysts lined with 'pale epithelium' could be found in normal as well as in cystic and cancerous breasts. He found them in all but 1 of 23 cases of cystic disease of the breast. He offered two possible explanations for the occurrence in the breast of this 'pale epithelium': (1) that genuine coiled sweat glands of the skin in the form of aberrant buds in breast tissue occurred and underwent cystic enlargement and (2) that the breasts since they are phylogenetically derived from 'sweat' glands in the course of their development by steps, remained behind in part, at a phylogenetically earlier stage nearer that of the 'sweat' glands. He considered the latter explanation more likely because he never saw in the breast typical quite normal sweat glands but instead saw sweat gland cysts which indicated to him a defective differentiation and favored an atavistic phenomenon.



In 1924 Krompecher (25) stated that the similarity between cysts of "pale epithelium" in the breast and cysts of the axillary sweat glands is so striking that they must be identical. He noted the unusual size of the cells their dublike appearance when distended and their firm occasionally granular or finely vacuolated cytoplasm which stained yellow with van Gieson's stain and reddish with eosin.

Ewing stated that true sweat glands are not present in the breast but that in many cases there is in the breast a type of gland which we speak of as sweat glands. I feel that this is a special form of gland structure in the breast which develops in a certain type of subject notably those with an oily skin and many sweat glands in other parts of the body. Some men think there is a transition between the ordinary acini and the sweat gland. He estimated that 25 per cent of mammary carcinomas arise from sweat glands distributed throughout the breast but mostly along the margins beneath the skin and in the axillary region. He described one form of cyst in chronic cystic mastitis as developing from the sweat glands in the breast.

Lee Pack, and Scharnagel agreed with von Eggeling's statement that the mammary and sweat glands are homologous structures which develop from a common primitive tubular type of epidermal gland. They stated their belief that sweat glands (apocrine) are normally present in every breast where they anastomose with and empty their secretions into the interlobular lacteal ducts. They said it is unimportant to determine whether the "pale epithelium" is anomalous embryonal normal or degenerative tissue their major premise being that the breast is a modified sweat gland and that the appearance of sweat gland tubules and cysts in the breast is a logical occurrence regardless of the mode of origin. They considered it significant that the anatomic and staining characteristics of this tissue remained throughout all the transitional phases of normal sweat gland tubule cyst intracystic papilloma adenoma and carcinoma.

In the same year Logie reported "pale epithelium" in 60 per cent of 330 malignant and nonmalignant tumors of the breast.

In January 1946 Foote and Stewart recognized sweat gland carcinoma as constituting 1 per cent of carcinomas of the breast and stated that it should properly be called apocrine sweat gland carcinoma. They expressed the belief that the cells of the ducts or lobules undergo apocrine metaplasia, and they found convincing transitions ranging from typical apocrine epithelium to apocrine epithelium in atypical hyperplasia to intraductal apocrine sweat gland carcinoma and, finally, to infiltrating carcinoma made up of apocrine-like cells.

#### SCHIMMELBUSCH HYPERPLASIA

As previously noted, "pale epithelium" has been described in many pathologic specimens from the breast especially in those which have been the seat of chronic cystic mastitis. It has been the custom at the Mayo Clinic, perhaps elsewhere also to describe the last mentioned specimens with the diagnostic appellation "chronic cystic mastitis with areas of Schimmelbusch hyperplasia." The latter portion of this term we consider incorrect.

Although Moallin in 1881 and Dreyfuss in 1888 had mentioned the pale structures, Schimmelbusch if he noted such tissue at all, made no specific mention of it. Under the title "cystadenoma of the breast" in 1890 (40) and again in 1892 (41) he gave his description of what he said had been described previously by Reclus (33-34) as *maladie kystique des mamelles*. He stated that he thought it should be called "cystadenoma," because in addition to the cyst formation there was growth or proliferation of the glandular tissue.

With hindsight it is possible to suppose that Schimmelbusch did see what we now call "pale epithelium" and that he described it as an intrinsic part of chronic cystic mastitis. However judging from his description one can merely say that he never described "pale epithelium."

In the years that followed other men used the term Schimmelbusch's disease synonymously with "cystic disease of the breast," "mastopathia cystica" or "chronic cystic mastitis," and so forth in their descriptions and discussions of "pale epithelium." Most of these workers in correlating the various de-

scriptions of the broad clinical and pathologic entity known most popularly as "chronic cystic mastitis," placed the phase described by Schimmelbusch at the upper, or more hyperplastic, end. This probably strengthened further the misconception concerning what Schimmelbusch saw and described (4 6 10 23 25).

Cheatle and Cutler in 1931 Cutler in 193 and Cheatle in 1935 stated that what Schimmelbusch described, they considered the neoplastic stage of cystiferous desquamative epithelial hyperplasia, and the pictures of the papillary epithelium shown by them as neoplasia are pictures of pale epithelium.

It thus may well be that Schimmelbusch actually saw what we now know as "pale epithelium." It would seem likely that he had seen it, since it is so commonly present in chronic cystic mastitis. However we have only his descriptions from which to judge and he does not mention pale structures or "pale epithelium" though he does mention papillary epithelial proliferations.

The use of the term "Schimmelbusch hyperplasia" at the clinic has been largely a matter of convenience and has been well understood. It was also recognized by most of the pathologists as incorrect, even before this study was begun in 1940. There is little doubt in the minds of most of these men that this "pale epithelium" regardless of its mode of origin is apocrine tissue and should be so designated. Some of the more recent contributions to the literature from other institutions indicate that this thought is by no means provincially unique.

#### PRESENT STUDY

**Material.** Six specimens of axillary skin were removed without selection simply in order that the scent glands in human beings might be studied (Figs 1 and 2).

Ninety-seven breasts were received in the surgical pathology laboratory directly from the operating rooms without any plan of selection except to accept whatever came in.

It had been noted previously by one of us (J. R. McD.) that there were tiny pinkish bits of tissue and equally tiny, bluish frequently macroscopically cystic bits of tissue to be found in most breast specimens and that

TABLE 1 — INCIDENCE OF PALE EPITHELIUM

Mammosis	Breasts				
	With pale epithelium				
	Total	Number	Percent	Macroscopic pink or bluish areas	
				Number	Percent
Carcinoma	51	4	7.8	96	61.4
Chronic cystic mastitis	20	20	100.0	0	0.0
Chronic fibrous mastitis	7	3	4.3	1	31.2
Intraductal papilloma	7	6	85.7	5	81.1
Chronic mastitis	6	3	50	3	100
Chronic paraneuritic mastitis					
Comedonitis					
Fibrous trophic mastitis					
Total	107	73	73.2	54	74.0

these bits of tissue usually were composed of pale epithelium (Figs 3, 4, 5, 6, and 7). Accordingly these were looked for and, if found, were removed in small blocks for sectioning and staining if none were found then blocks were cut at random from the breast. All specimen blocks were cut from the depths of the breast proper the subcutaneous areas being avoided.

Pale epithelium was found in three-fourths of all the breasts examined, and in three-fourths of the instances in which it was present it could be found with the naked eye (Table I). It should be stated that the pink and bluish areas mentioned varied from 0.5 millimeter to 3 or 4 millimeters in diameter. Larger areas (always bluish) were not used, because the cystic dilatation and expansion had flattened the epithelium. The term "blue-domed cyst" has been applied by at least one man to these bluish structures, but since this term has been used in a grossly descriptive way—not implying any specific tissue but merely a gross, refractive phenomenon and a lack of malignancy—I feel that this term would be misleading if used to indicate these pale epithelial cysts (Table II).

**Intracellular granules.** The mere noting of intracellular granules in the pale epithelium was not difficult. The presence of granules of one kind or another was open to argument only in those instances in which the epitheli-

TABLE II — INCIDENCE OF CYSTIC CHANGE IN PALE EPITHELIUM ON MICROSCOPIC EXAMINATION

Diagnosis	Breasts with pale epithelium		
	Total	Cystic changes	
		Number	Per cent
Carcinoma		23	86.4
Chronic cystic mastitis	30	30	100
Chronic fibrous mastitis	3		00
Intraductal papilloma	6		66
Chronic mastitis	3		100
Total	72	69	86.3

um was moderately or considerably flattened as a result of cystic dilatation of the epithelial glands. As a rule the granules were quite obvious. Sometimes they stood out in a most striking manner showing extremely marked eosinophilia (Table III). There were several types of granules. The great majority were eosinophilic granules large or very fine which stood out even against the smoothly eosinophilic cytoplasm (Fig 5). Then there were yellowish or brownish granules—present in only a few of the cells of any particular acinus of pale epithelium—which were even more readily visible in the sections stained with Berlin blue but which were apparently untouched by either of the two stains, Berlin blue or hematoxylin and eosin (Figs. 5 and 6).

Another type of granule was a very fine one—also not present in all the cells—which gave a fat reaction with the sudan III stain in the few such slides which were made. There were noted also some fat droplets of varying size in a few of the cells (Fig 6).

Finally there was the type of granule which gave a positive reaction to the Berlin blue stain. Whether this one was identical with one of the previously mentioned types or represented a different metabolic stage of one of them was not established in this study. Certainly when numerous markedly eosinophilic granules were seen in the section stained with hematoxylin and eosin there was no correspondingly marked iron reaction in the section stained with Berlin blue. While there were usually a few cells found which contained a few or many granules giving a positive reac-

TABLE III — INCIDENCE OF INTRACELLULAR GRANULES IN PALE EPITHELIUM AND OF POSITIVE STAIN FOR IRON

Diagnosis	Breasts with pale epithelium				
	Total	Intracellular granules		Positive reaction to stain for iron	
		Number	Per cent	Number	Percent
Carcinoma			00	20	97.6
Chronic cystic mastitis	30	30	100	30	100
Chronic fibrous mastitis	3	3	100	3	100
Intraductal papilloma	6	5	83.3	5	83.3
Chronic mastitis	3	3	100	3	100
Total	72	71	97.6	67	

tion to the stain for iron there was not a universally present iron reaction in all the cells. There was extreme variation in the iron reaction not only from cell to cell but from gland to gland or acinus to acinus, in the same slide. Although in a few instances there was a suspicion of a positive iron reaction in the cells of some of the regular mammary epithelium this was not definite enough to deny the pale epithelium the uniqueness of this reaction.

*Hyperplasia and papillary formation.* Although papillary formation seemed to indicate growth activity or even overactivity it was sometimes noted when there was no evidence of hyperplasia. Usually however hyperplasia and papillary formation were seen together and if hyperplasia were present papillary formation was always present also (Table IV).

Hyperplasia was adjudged present principally on the basis of individual changes, differences and appearances of cells and not merely because of an increase in the number of cells. If the nuclei of some of the pale epithelial cells were one and a half to two times as large as the nuclei usually seen and if they were hyperchromatic and contained multiple, large, hyperchromatic nucleoli or mitotic figures, then the cells containing them were considered hyperplastic (Fig 8).

*The myoepithelium.* At first it was somewhat difficult to be certain about the myoepithelial cells (Fig 6) but as more slides were examined and some very definite examples were seen, then the less obvious cells became more apparent. These cells are easily confused

with cells in the capillary walls lying immediately nearby, outside the basement membrane but this confusion, noted in the literature would seem more often to be due to cells, possibly reticular cells, which are seen actually in the basement membrane which are very similar to the cells in capillary walls. The myoepithelial cells lie directly beneath the epithelium, above or on the basement membrane.

The myoepithelial cells are long spindle shaped and not too numerous or closely packed in the unchanged gland or acinus. They seem as a rule to be thicker at the middle than at the ends, like the cells of the capillary walls and when they apparently participate in hyperplastic activity they multiply in to a definite layer and appear more like epithelial cells than the smooth muscle cells which they usually resemble.

**Age** There was no great difference in average age between the group of patients whose breasts did contain pale epithelium and the group of patients whose breasts did not contain pale epithelium. The respective average ages were 47 and 49 years.

**Relation of pale epithelium and papillary formation to the menopause** Sixty five per cent of the specimens of breast with pale epithelium which showed papillary formation or papillary formation with hyperplasia, came from women past the menopause or in the midst of the menopause. This does not imply necessarily that the menopause, with its hormonal changes is solely responsible for the occurrence of pale epithelium but it might suggest that the menopausal and postmenopausal hormonal imbalances may be related to the histologic evidences of growth activity. Speert's experimental work with estrogenic hormones is very pertinent in these respects.

#### COMMENT AND SUMMARY

There is little doubt in our minds that the pale epithelium discussed in this study found in breasts and illustrated in Figures 3, 4, 5, 6, 7 and 8 is actually apocrine glandular tissue identical with the axillary apocrine scent glands (Figs 1 and 2). This is not an original concept and this study has not conclusively proved the identity. Truly conclusive proof

TABLE IV—INCIDENCE OF PAPILLARY FORMATION AND HYPERPLASIA IN BREASTS WITH PALE EPITHELIUM

Diagnosis	Breasts with pale epithelium				
	Total	Papillary formation		Hyperplasia	
		Number	Per cent	Number	Per cent
Carcinoma	41	20	48.8	13	31.7
Chronic cystic mastitis	20	9	45	8	40.0
Chronic fibrous mastitis	3		33.3	0	
Intraductal papilloma	6		33.3		33.3
Chronic mastiti	3		66.7	1	33.3
Total	73	34	46.6	24	32.9

would rest on a cellular biochemical study with identification of secretions from the tissue. Nevertheless it would seem justifiable to consider this tissue to be apocrine scent gland tissue on the basis of similar staining and morphologic characteristics.

We have refrained except where unavoidable for clarity's sake from referring to this pale epithelium as sweat glands, sweat gland epithelium, apocrine sweat glands or by any other term which is suggestive of sweat or sweat glands. Apocrine glands generally the scent glands in particular are not sweat glands as Schiefferdecker showed. The latter term has been inappropriately and inaccurately applied to them because they lie in the skin and morphologically are coiled glands. Their function in man has no bearing on the control of body temperature and they do not excrete large amounts of water and metabolites such as urea, instead they elaborate a definite substance or secretion which itself has a role in the primitive animal economy.

The breast is an apocrine gland on the basis of its mode of secretion that is all that the term "apocrine" indicates. The breast is also a highly specialized modification of a certain primitive cutaneous gland the latter being likewise parent to the scent gland (also an apocrine gland). Neither of these glands 'sweats' in the manner of the eccrine or eccrine or true sweat gland. They secrete rather than excrete a definitely elaborated substance, the elaboration occurring in the cells of the glands. The excretory function of the eccrine gland,

on the other hand, is closely akin to that of the renal tubule

The mere anatomic location of the scent glands that is in the skin as well as some of their morphologic characteristics led quite naturally to the inaccurate appellations sweat glands then large sweat glands and more recently apocrine sweat glands. In the same way the breast is referred to as a modified sweat gland though nobody considers that the breast sweats or that its secretion is sweat.

The term apocrine glands when applied to the breast, the scent glands the ceruminous glands and so forth is accurate as far as it goes but it merely denotes a group of glands distinctive as to their method of secretion. Since these glands have also their origin in common the term apocrine skin glands might temporarily suffice as an over all group name.

The scent glands could well be known in addition and separately as the scent glands or odoriferous glands or accessory sexual glands. Such terms have been suggested as mentioned previously and they are as fully individual and distinctive as the term mammary gland or the term ceruminous gland. The pale epithelial structures encountered in the breast might then be referred to as scent gland tissue in the breast or accessory sexual gland tissue in the breast. There is of course some redundancy here since the breast might very well exhibit and contain such pale epithelium as an expected thing inasmuch as the breast is a modification of the same primitive gland from which the scent gland is derived and inasmuch as the scent gland in its characteristics does not seem to be far removed or greatly modified from the primitive glands. Hence such epithelium might be considered the primitive epithelium and its presence in the breast merely evidence of a reversion in part even though the stimulus for such reversion might be a hormonal one.

Even more to be expected perhaps, is the finding of this pale epithelium in supernumerary or accessory breasts and especially in so-called aberrant breasts. As mentioned in the review of the literature breastlike structures have been described on most parts of the body including the extremities. There is no doubt about the finding of true breast tissue

in the supernumerary or accessory breasts, but this does not necessarily indicate that all of the structures described as breasts or breastlike structures or aberrant breasts actually are composed of breast tissue. Obviously many of these structures are outside the embryologic milk line and may well be and probably are hypertrophied apocrine glands of the more primitive or scent gland type. Even those which are in the milk line and are more breastlike may well be of the primitive type of apocrine gland but are simply further along in the differentiation to breasts as required of such glands lying in the milk-line. As H. E. Walter stated in 1903 no known mammal living or extinct has, or had, as many mammae as there are recorded sites for accessory breasts, so called. The only alternative explanation is that these aberrant breasts are really hypertrophied primitive apocrine glands, which being outside the milk line and therefore lacking the undefined embryologic and phylogenetic stimulus for specific organ formation that is breast formation are unable to form true breasts. The gross caricature therefore is to be expected, and the misinterpretation there by is easily explained.

As already mentioned we consider the pale epithelium to be a relatively normal finding in the breast. If we consider the breast as a stable organ exhibiting little change except slowly and over long periods of time, then the occurrence of somewhat primitive epithelium, that is the pale epithelium could be considered definitely abnormal. However as has been remarked by many workers (Ingleby and others) the breast is not normal it is not static but it is a rapidly frequently changing organ which is subject to many and diverse influences. Monthly it goes through a series of elaborate growth changes in preparation for a specific function. In view of these facts the finding of pale epithelium that is the presumptive primitive epithelium not only does not seem extraordinary but seems to be normal. This pale epithelium in the breast, however might be explained somewhat differently. Its function may be to impart the characteristic mammalian racial, and individual odor or odors to the milk a hangover in the human being from more primitive evolutionary stages.

It is our impression that pale epithelium could be found in every breast if diligently sought after. Although arriving at an entirely different conclusion about it, Dawson stated that the pale structures are to be expected in practically every pathologic and cystic condition of the breast malignant or not. She found such structures in 116 of 120 breasts which were the sites of malignant lesions and in all of 48 cystic breasts. Prym, and Berka have ever reported pale epithelium in otherwise normal breasts, and it is our opinion that it can be found in any and all female breasts after the age of puberty. That it seems to be increased in quantity in breasts which are the sites of certain pathologic conditions such as carcinoma and chronic cystic mastitis seems to us further evidence of a hormonal relationship or dependency. The question of the possession of carcinogenic properties by hormones especially the sexual hormones is well known and is frequently discussed. If one assumes an excess or increased potency of certain ovarian hormones as a possible explanation or cause of chronic cystic mastitis and carcinoma of the breast, there is no reason to deny the assumption that side effects occur such as an increase in the amount of pale epithelium in the breast. That pale epithelium will appear in response to the action of estrogenic hormones for instance would seem to be strongly suggested by Speert's experimental work. This may account for the easily noted high incidence of pale epithelium in breasts which are the sites of chronic cystic mastitis for instance. This is not an original concept other men having noted something of a relationship between chronic cystic mastitis and adnexal disease (48). The pituitary hormonal fractions undoubtedly play some direct or indirect role in this relationship and are under wide discussion in the literature.

Lee Pack and Scharnagel have noted much more pale epithelium in the breasts of patients with oily skin and much body hair than in breasts of persons with less oily skin and less body hair. This again would indicate a pituitary-gonadal relationship which is necessarily hormonal in character. Semb found an increased incidence of chronic cystic mastitis in nulliparas but made no study of the inci-

dence of pale epithelium though, judging from the present study as well as others mentioned the incidence should have been very high. The most obvious conclusion from all this would be that estrogenic hormone has direct control over the occurrence of pale epithelium in the breast but the involved endocrine gland relationship in the human being would make this a risky conclusion without further experimental work.

In so far as chronic cystic mastitis is concerned there is no doubt that the cystic changes occurring in the pale epithelium contribute to the grossly cystic character of the pathologic picture and indeed some men consider the disease one solely of pale epithelial structures (4). In view of the frequent association of chronic cystic mastitis with carcinoma of the breast (30), it is even possible to explain on this basis the reported findings (our own also) of a relatively high incidence of pale epithelium in carcinomatous breasts.

The question that a malignant lesion the so called sweat gland carcinoma of the breast may arise from the pale epithelium is still debated. From a practical standpoint the tissue of origin of a carcinoma of the breast is of little significance to the patient since low grade carcinomas arising from the usual or normal mammary tissue have metastasized and killed and since high grade carcinomas similarly arising have apparently been cured. It would be of significance to determine the tissue of origin only if it were known or could be shown that carcinomas arising from pale epithelium were usually low grade slow growing and slow to spread or were usually high grade fast growing and fast spreading. This would then be of prognostic significance and value. However as remarked by others (14) various gradations have been noted as occurs among carcinomas arising from the usual or normal mammary tissue. This has been our experience. Of the 54 carcinomatous breasts which we examined there were 8 malignant lesions (15 per cent) which might be termed so called sweat gland carcinoma or more properly scent gland carcinoma of the breast (Fig 9). However, the argument as to the distinction or separation of such carcinomas of the breast seems unnecessary and superfluous in

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# VAGINAL OPERATIONS FOR CYSTOCELE, PROLAPSE OF THE UTERUS, AND STRESS INCONTINENCE

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**P**ERHAPS the most important factor in the etiology of prolapse is a loss of tone of the plain muscle tissue of the endopelvic fascia and it is for this reason that the worst cases are seen in women of menopausal age or in postmenopausal patients. Other important factors are loss of tone of the levator ani muscles themselves and separation of the two levator muscles where they come together in the region of the perineal body as the result of lacerations during childbirth. The work of Halban and Tandler (2, 6) and Amreich (4) particularly has emphasized the distinction between the endopelvic fascia and the pelvic fascia which covers the levator ani and obturator internus muscles. Although it may be difficult and sometimes impossible to define the endopelvic fascial layers by histology (Goff) they can be demonstrated quite easily at operation. More over for successful plastic surgery in the treatment of prolapse a detailed knowledge of the anatomy of the different layers is required. It is the purpose of this paper to call attention to certain anatomical details and to show how this knowledge can be applied to vaginal plastic surgery.

## VAGINAL OPERATIONS ANATOMY OF THE VAGINAL WALLS

In the anterior vaginal wall immediately above the level of the urethral meatus and the anterior termination of the hymen is a transverse groove which I have called the submeatal sulcus (Fig. 1, 5). I believe that the sulcus indicates the position of the urogenital diaphragm. In the anterior vaginal wall about 3 centimeters above this level is a second groove which I have called the transverse sulcus of the anterior vaginal wall. This sulcus corresponds approximately to the level of the junction of the urethra with the

bladder although it is produced as the result of the topography of an underlying fascial layer. The upper limit of the bladder in the anterior vaginal wall is defined by a sulcus which is best referred to as the bladder sulcus. A little above the level of the meatus in the anterior vaginal wall on each side is an oblique vaginal fold which passes downward and forward from the lateral side of the vagina. Between the transverse sulcus and the submeatal sulcus the vaginal wall is rugose.

In some cases of prolapse the area of the vagina between the submeatal and transverse sulci is prolapsed and stretched when the two sulci can be easily identified. At other times the two sulci remain approximately in their normal position. In cases of cystocele the main part of the prolapse is almost always between the transverse and bladder sulci. In the surgical treatment of cystocele the object should be to prevent the bladder from prolapsing in the area between the transverse vaginal and the bladder sulci.

## ANATOMY OF THE VAGINAL FASCIAL LAYERS

If the cervix is pulled down in a case of prolapse so that the anterior vaginal wall is put on the stretch, and a midline incision made, a plane of cleavage called by Amreich the vesicovaginal space can be exposed. The vaginal layer of endopelvic fascia remains adherent to the vagina while the thin vesical fascia adheres to the bladder. The vaginal fascia varies in thickness whereas the vesical fascia is always thin and never well defined. The vesicovaginal space is relatively bloodless and in operations for cystocele if the correct layer of cleavage is found hemorrhage is reduced to a minimum. In old standing cystoceles the space may be obliterated by fibrous tissue and separation is then only possible with a scalpel.

Between the transverse vaginal sulcus and the submeatal sulcus there is no plane of

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view of the close intimate relationship other than physical of the tissues. On the other hand the morphologic and staining distinctions of the pale epithelium in the breast would indicate a metabolic and functional distinction and difference which in turn might result in and indicate quite different proliferative potentialities

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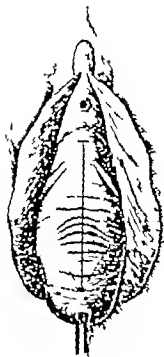


Fig. 3

Fig. 3. Incisions employed for anterior colporrhaphy. The oblique lines indicate the inclination for different degrees of severity.

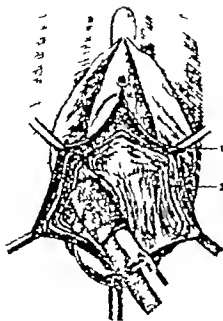


Fig. 4

Fig. 4. Dissection in the vesicovaginal space. The bloodless layer is best found by stripping gently with

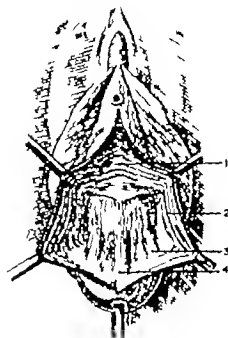


Fig. 5

gauze wrapped round the finger 1 Posturethral ligament 2 Vaginal fascia.

Fig. 5. Exposure of the vesicovaginal space. 1 Posturethral ligament, 2 Vaginal fascia, 3 Bladder septum, 4, Vesicocervical ligament.

vesicocervical space is one of the most important steps in operations for prolapse

#### OPERATIONS FOR CYSTOCELE

In cystocele the bladder prolapses in the area between the transverse vaginal sulcus and the bladder sulcus of the anterior vaginal wall. In some cases the posturethral ligament remains firm and hardly prolapses at all while in other cases the ligament is stretched so that the transverse vaginal and the submental sulci are well defined on the prolapsed part. Theoretically the objects of any cystocele operation are first, to mobilize the bladder and to return it to its normal position and secondly to close the area between the upper border of the posturethral ligament and the cervix in such a way that the bladder will not prolapse again. It is insufficient to close the hiatus with the vaginal wall alone for this may stretch again nor is it satisfactory to close the space with the vaginal endopelvic fascia the weakness of which is one of the fundamental causes of the development of the prolapse. This view is at variance with the present day practice. For many years I em-

ployed and devised different methods of pleating and overlapping the fascial tissues which intervene between the anterior vaginal wall and the bladder to form a supporting shelf. Experience has shown that such methods are unnecessary and the method which I describe in the following gives equally good results. The strongest supporting tissue in the vicinity is the posturethral ligament. For this reason I maintain that the bladder must be mobilized and pushed upward and the space closed by suturing the posturethral ligament directly to the cervix itself. This is the fundamental principle of the operation.

I make a midline incision which ultimately passes from the submental sulcus to the bladder sulcus (Fig. 3). From the cervical end of this incision I make a lateral incision on each side. The inclination of the lateral incision depends upon the severity of the prolapse. First the vesicovaginal space must be opened up. The space is found most easily at the cervical end of the incision. The best way is to apply traction to the lower angles of the vaginal flaps. I do not believe that there is any risk of injury to the bladder if ordinary care is

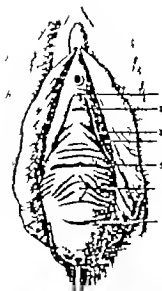


Fig. 1. Anatomical details of the anterior vaginal wall. 1 The hymen. 2 The submental sulcus. 3 Paraurethral recess. 4 Oblique vaginal fold. 5 Transverse sulcus of the anterior vaginal wall. 6 Arched rugae of the vaginal wall. 7 Bladder sulcus.

cleavage for the vesical and vaginal fascias are fused in this area (Fig. 2). There is however a loose space in the vicinity of the rugosities, between the fused fascias and the skin of the vagina with its thin layer of vaginal fascia. A scalpel is required to separate the vaginal wall from the underlying fascial layers in this region.

The fascial tissues which lie deep to the vaginal wall between the submental and transverse sulci form a specialized condensed layer of fascia which I have called the posturethral ligament. To appreciate the importance of the ligament dissection should be made either on a cadaver or at operation in a case of cystocele of slight degree. The ligament extends from an attachment to the pubic ramus of one side below and behind the urethra and the neck of the bladder to the pubic ramus of the opposite side and forms a dense sheet of tissue which supports the urethra and the neck of the bladder. The upper border is well defined and is responsible for the formation of the transverse vaginal sulcus. The ligament mainly consists of plain muscle tissue and if the muscle tone is lost the ligament stretches which leads to urethrocele and contributes to the development of a cystocele. These views

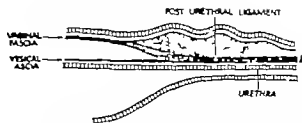


Fig. 2. Anatomy of the fascial layers in the vicinity of the external urinary meatus (diagrammatic). On the left the vaginal fascia and vesical fascia are separated by the vesicovaginal space. Nearer the urethra the vaginal fascia splits into two parts, a thin layer remains attached to the rugosities of the vaginal wall and is continued forward to point a. The greater part of the vaginal fascia fuses with the vesical fascia to form the posturethral ligament b. Between a and b the tissue is loose connective tissue, which must be cut through with the sharp end of scalpel.

are different from those held by Kennedy. All gynecologists must have recognized the condensation of fascia around the urethra, and the term paraurethral fascia is sometimes used. In view of its condensed consistence of the lateral attachments and the well defined upper border in my view it should receive separate terminology and I have suggested the term posturethral ligament.

Passing from the vesical fascia to the cervix and in consequence fixing the bladder to the cervix is a thin sheet of endopelvic fascia called the vesicocervical ligament (Amreich). On each side the ligament passes into the bladder septum which is a thicker layer of endopelvic fascia which attaches the bladder to the lateral aspect of the cervix. A plea for uniformity of terminology may conveniently be made at this stage. The various fascial layers are known to operating gynecologists, but gynecologists tend to use different names for the same structures. Such terms as subvaginal fascia, paravaginal fascia, pubovesical ligament, pubocervical ligament, pillars of the bladder are employed. The terminology of Tandler and Amreich which I have employed seems to be the most exact and most scientific.

If the cervix is pulled down and the vesicocervical ligament stretched and then divided a bloodless space is found between the bladder and the cervix. This space is called the vesicocervical space. The bladder cannot be mobilized unless this space is defined and until the bladder septa have been divided with scissors. Indeed in my view the identification of the

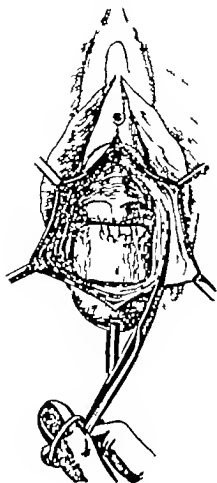


Fig. 9

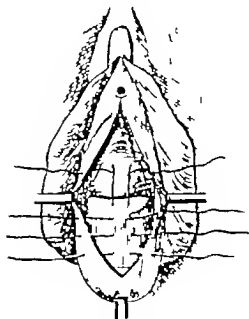


Fig. 10.

Fig. 9. Excision of the redundant vaginal wall together with the vaginal fascia.

Fig. 10. The key sutures. Above, the suture passes first through the vaginal wall together with its vaginal fascia, then through the post-urethral ligament, then through the front of the cervix, then through the post-urethral ligament and the vaginal wall of the opposite side. The lower sutures pass through the vaginal wall and the vaginal fascia, then through the front of the cervix and then through the vaginal fascia and the vaginal wall of the opposite side.

stretched and sometimes it may be necessary to pass the suture through the uterovesical pouch. The suture is then passed through the post-urethral ligament on the other side of the midline at a corresponding point and then through the vaginal fascia and vaginal wall as before. When this suture is tied the space through which the bladder can prolapse is obliterated completely (Fig. 11). Reinforcement sutures can be introduced when necessary.

In my view this particular suture is one of the most valuable in the whole of vaginal surgery for prolapse. Sometimes a series of interrupted sutures can be passed between the post-urethral ligament and the front of the cervix and many minor modifications of the technique are obviously possible. Clearly one of the great advantages of the technique is that the urethra is stretched longitudinally, which is of the utmost service in the cure of stress incontinence.

No effort is made to dissect the vaginal fascia from the vagina and to interpose a layer of

fascial tissues between the vaginal wall and the cervix for the view is taken that the fascial layers are tonic in cases of prolapse and have little supporting action. The cervix part of the incision is now closed with interrupted sutures. Each suture passes through the vaginal wall and vaginal fascia, then through the front of the cervix and then through the vaginal fascia and vagina of the opposite side. This series of stitches should close still more the pre-existing space through which the bladder has prolapsed. At the other end of the incision it may be thought advisable to introduce a series of interrupted Lembert sutures through the post-urethral ligament if there is a tendency to urethrocele or stress incontinence. The cut vaginal wall is then closed by a series of interrupted sutures.

A self retained catheter is introduced into the bladder and retained for at least 5 days. It is found in practice that most patients have great difficulty in voiding urine for nearly a week after the operation. The end results are extremely satisfactory.

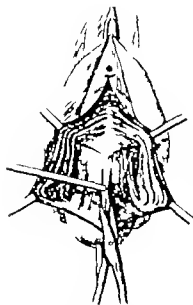


Fig. 6.

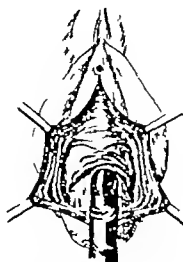


Fig. 7

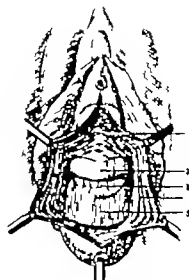


Fig. 8.

Fig. 6. Division of the vesicocervical ligament

Fig. 7. After the vesicocervical space has been exposed the bladder is mobilized upward. The bladder septa must first be cut through.

Fig. 8. Exposure obtained after mobilization of the bladder. 1. Posturethral ligament. 2. Bladder. 3. Peritoneum of the uterovesical pouch. 4. Vaginal fascia. 5. Front of the cervix.

taken. If the correct layer is found the vagina, together with its fascia, strips easily and a few delicate touches with the scalpel combined with separation with dry gauze wrapped round the finger will open up the space as far upward as the posturethral ligament (Fig. 4). If the correct layer is found there is little or no hemorrhage for the vaginal vessels lie in the vaginal fascia and the vesical vessels lie in the vesical fascia. When the posturethral ligament is reached it is necessary to use a scalpel to cut through that part of the vaginal fascia which merges with the posturethral ligament and over the surface of the posturethral ligament a scalpel must be used to separate the vagina with its rugose pouches from the ligament (Fig. 5). The next step is the usual division of the vesicocervical ligament and the division must be carried sufficiently deeply to expose the bloodless white space of the vesicocervical space (Fig. 6). The bladder cannot be sufficiently mobilized however until the bladder septa have been divided to a moderate extent on each side. The bladder must be mobilized sufficiently so that it can be pushed upward to expose the uterovesical pouch of peritoneum (Fig. 7). The next step is to excise

the redundant vaginal wall and its underlying fascia from the two lateral flaps and it is at this stage that the vaginal vessels are divided and they must be ligatured separately (Figs. 8 and 9).

The crucial suture is now introduced. It passes through the vaginal wall and vaginal fascia, starting at a point 3 to 4 centimeters below the meatus, about  $\frac{1}{2}$  centimeter from the cut edge. The needle is passed through both the vaginal wall and the vaginal fascia (Fig. 10). It is then passed through the posturethral ligament on the same side of the midline. There is plenty of tissue to pick up and there is no risk of injury either to the urethra or to the bladder. Before the suture is passed through the ligament the ligament should be pulled upward in the direction of the cervix and the ligament should be transfixed in the average case about half way between the submental sulcus and the cervical edge of the posturethral ligament. The suture is now passed through the front of the uterus. The level of the uterus at which the suture is introduced depends upon the severity of the case. The higher the level of the uterus at which it is introduced the more the urethra will be

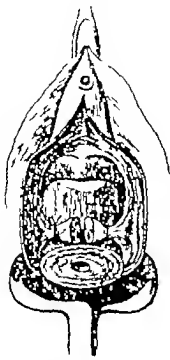


Fig 14.

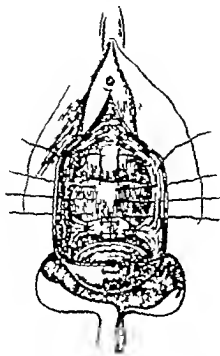


Fig 15

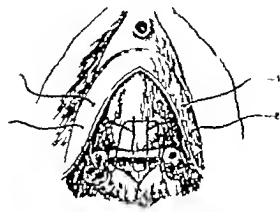


Fig 16

Fig 14. Manchester Fothergill operation. The cervix has been amputated and the lateral pedicles brought forward in front of the cervix.

Fig 15. Manchester Fothergill operation. The post-urethral ligament is sutured to the front of the cervix as in the operation of anterior colpoperthaphy, the lower sutures of anterior colpoperthaphy are also introduced, while below the lateral pedicles are sutured together and also to the front of the cervix. The theoretical object is to define Mackenrodt's ligament and to put the ligaments on the stretch by stitching them to the front of the cervix in the midline.

Fig 16. Vaginal hysterectomy for prolapse. Suture No. 1 passes through the vaginal wall and vaginal fascia, then through the posturethral ligament, then through the peritoneum. Afterward it passes through the corresponding structures of the opposite side. In this case the peritoneum replaces the uterus in the anterior colpoperthaphy technique. Suture No. 2 passes through the vaginal wall and fascia, then through the stump containing the round ligament, ovarian ligament, and fallopian tube, then through the posturethral ligament, and afterward through the corresponding structures of the opposite side.

a scalpel the fascial tissues lying on the lateral side of the cervix are cut away from the cervix and mobilized for at least  $\frac{1}{2}$  inch above the level at which the Weibel clamp has been placed (Fig 13). The same procedure is carried out on the opposite side. If the scalpel cut is sufficiently close to the cervix the risk of hemorrhage is small. Next, the tissues enclosed in the Weibel clamps are ligatured and the ligatures can then be regarded as being attached to the lower ends of Mackenrodt's ligaments. The next step is to suture these two ends to the front of the cervix in the midline and to pass a few interrupted sutures to stitch the two ends together (Figs 14 and 15). The theoretical object of the technique is to define Mackenrodt's ligaments and to put the ligaments on the stretch by stitching them to the front of the cervix in the midline. Moreover, the technique tends to make the uterus anteverted. Some experience is required to determine the extent to which the fascial tis-

ues should be mobilized. Obviously if this method is to be employed the Weibel clamp must not include any part of the vaginal epithelium. The cervix is then covered in the usual way by the Bonney Sturmdorf technique.

#### VAGINAL HYSTERECTOMY FOR PROLAPSE

The variations possible in this technique are almost countless for much depends upon the severity of the associated cystocele and prolapse of Douglas pouch.

A midline incision in the anterior vaginal wall is first made and the lateral incisions at the level of the bladder sulcus are placed transversely. The two vaginal flaps are dissected away as in the anterior colpoperthaphy technique. The vesicocervical ligament is divided, the vesicocervical space is opened up and the bladder mobilized. If the cystocele is extensive the bladder should be invaginated with a pursestring suture or with a series of

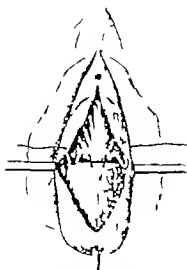


Fig. 1

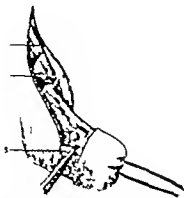


Fig. 2

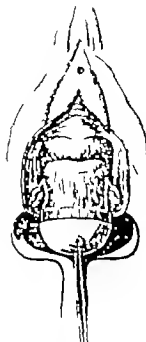


Fig. 3

Fig. 1. The illustration shows how the tightening of the anterior key suture brings down the posturethral ligament and fastens it to the front of the uterus and cervix. In this way the ligament is elongated and the space through which the bladder has prolapsed becomes closed.

Fig. 2. Manchester Fothergill operation. 1 Posturethral ligament. 2 The bladder. 3. A clamp placed on the tissues which pass down laterally to the cervix.

Fig. 3. Manchester Fothergill operation. After the lateral tissues have been ligatured the temp is mobilized

by means of incisions placed immediately lateral to the cervix.

#### THE MANCHESTER FOTHERGILL OPERATION

The principles of the method of anterior colporthaphy are incorporated in the technique I use for the Manchester Fothergill operation. A midline incision in the anterior vaginal wall is first made and the lateral incisions in the vicinity of the bladder sulcus are made at right angles, but are not at first carried round the cervix to circumsise the cervix. The lateral vaginal flaps are dissected away as before the vesicocervical ligament divided and the bladder mobilized. The lateral vaginal flaps are excised and the key sutures passed through the vaginal wall vaginal fascia posturethral ligament and the front of the supravaginal portion of the cervix exactly as in the anterior colporthaphy technique (Fig. 15).

The next step is to continue the lateral incisions around the cervix and the level at which the incision is made depends upon how much of the cervix is to be removed. Next on each side a strong curved clamp of the Weibel pattern is used to clamp the paracervical fas-

cial tissues which enclose the vessels which run laterally along the cervix (Fig. 12). If prolapse of the uterus is well marked the clamp is placed on the fascial tissues alone but if the prolapse of the cervix is only of a moderate degree it may be expedient to enclose the squamous epithelium layer covering the back of the cervix in the clamp for the cut surface exposed after the cervix has been amputated can be covered with epithelium more easily if this step is taken.

The Manchester Fothergill operation gives exceptionally good results in selected cases, probably because redundant vagina from the vicinity of the posterior fornix is stretched to cover the cut surface of the posterior half of the cervix. If there is well marked prolapse of the uterus Mackenrodt's ligaments are stretched and the slackened ligaments must be tightened at operation. To carry out this procedure satisfactorily the following technique is employed. The cervix is amputated in the usual way and with the help of volsellum forceps the cut surface of the cervix is pulled to one side. With

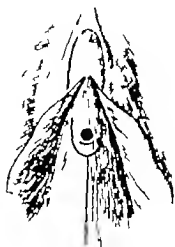


Fig. 19

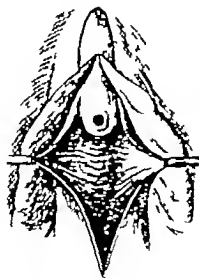


Fig. 20

Fig. 19. Operation for stress incontinence. The incision is semicircular around the external meatus, with a prolongation upward in the midline along the anterior vaginal wall. The incision allows the lower part of the urethra to be mobilized.

Fig. 20. In this step the lateral flaps are being dissected away in order to expose the urethra along its whole length.

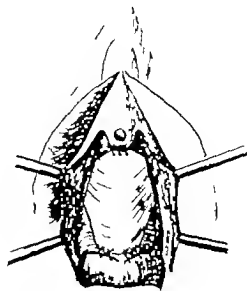


Fig. 21

Fig. 21. The sling has been sutured in position. Above one edge of the broad part of the sling has been sutured to the skin remaining around the urethral meatus. It is not advisable to introduce stitches into the wall of the urethra in this region. The other edge of the sling is sutured directly to the cranial margin of the post-urethral ligament. On each side the thin ends of the sling pierce the tissues lying lateral to the urethra.

making a longitudinal incision in the posterior vaginal wall from the opening in Douglas pouch otherwise the ligaments cannot be exposed sufficiently accurately (Fig. 17). The tissues contained in the other clamps are sutured together by the usual Mayo-Ward method, and it is often expedient to delay this suturing until this stage of the operation has been reached.

#### OPERATIONS FOR STRESS INCONTINENCE

Vaginal operations for the relief of stress incontinence have none factor in common—the originators always claim good results. It is doubtful whether the Stoeckel Goebell technique, or the more modern Aldridge method of sling operation, should be employed unless efforts at vaginal repair have failed. I am quite satisfied that if the urethra is elongated in the methods I have described for anterior colporrhaphy the Manchester Fothergill operation and vaginal hysterectomy the stress incontinence is usually relieved provided that the elongation is of a sufficient degree. Furthermore it is quite simple to interpose an additional supporting shelf beneath the urethra by a series of Lembert's sutures through the post-

urethral ligament. Indeed I have obtained better results by such methods than by the Kelly technique. The etiology of stress incontinence is obscure and I am convinced that there are many underlying etiological factors. Some of the worst cases result from anterior colporrhaphy when I believe the nerve supply to the voluntary urethral sphincter is divided. In the average case of stress incontinence the external meatus is patulous and prolapsed downward and forward and together with the lower  $\frac{1}{2}$  inch of the urethra projects well below the inferior pubic angle.

I think most gynecologists will agree that in a certain proportion of cases stress incontinence recurs after relatively simple vaginal operations. Moreover, the worst cases to deal with are those in which the symptom is present without accompanying cystocele or prolapse of the uterus. Often, the only physical signs are a patulous external meatus combined with prolapse of the urethra and the lower third of the anterior vaginal wall. I have never been particularly impressed with the Stoeckel Goebell or the Aldridge operation, mainly because the fascial strips which act as a sling are too narrow. I have therefore, attempted to



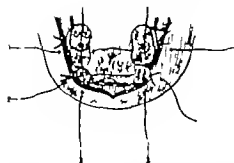


Fig. 7. Vaginal hysterectomy for prolapse. Suture No. 1 brings together the mid-pedicle. Suture No. 2 brings together the pedicle of the uterosacral ligaments. If there has been an enterocele, suture No. 3 passes through the uterosacral ligament pedicle, then through the mid-pedicle and passes in front to be sutured to the post-urethral ligament. Sutures 1 and 2 of Figure 15 and suture 3 of Figure 6 are not tied until all three sutures have been introduced.

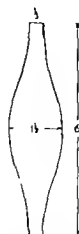


Fig. 8. The fascial strip taken from the fascia lata showing the approximate measurements.

reefing sutures. The uterovesical pouch is now opened up and the layer of peritoneum near the bladder grasped with long Kocher's forceps. The anterior wall of the uterus is pulled through this opening in the peritoneum and the fundus of the uterus drawn downward. A series of Weibel's clamps is next placed along each side of the uterus and the uterus separated with a scalpel as far down as the uterosacral ligaments. The cervix is drawn upward and the circumcision of the cervix completed by joining the lateral ends of the original incision behind the cervix. The situation of this posterior incision through the vaginal wall depends upon the extent of the enterocele. The next step is to draw the fundus of the uterus downward and to put on the stretch the herniated peritoneum of Douglas pouch. In this way the peritoneum can be mobilized and the hernial sac, if present, can be excised with scissors. After this, the uterosacral ligaments are clamped and the uterus removed by cutting with a scalpel on the uterine side of the clamps. I now place ligatures around the tissues enclosed in the clamps but do not remove the clamps themselves at this stage. A series of key sutures is then introduced (Fig. 16). The first passes through the vaginal wall and vaginal fascia about  $1\frac{1}{2}$  inches below the level of the urinary meatus. It then passes through the post-urethral ligament half way between the meatus and the cervical edge of the post-urethral ligament. Next it passes

through the peritoneum which was grasped in the Kocher's forceps after which it passes through the post-urethral ligament of the opposite side and then through the vaginal fascia and vaginal wall of this side. The suture is not tied at this stage. A second key suture is now introduced. It passes through the vaginal wall and vaginal fascia at a point a little below the introduction of the previous stitch. It then passes through the tissues enclosed in the first clamp which consist of the fallopian tube round ligament and ovarian ligament. It passes through the post-urethral ligament of the opposite side then through the tissues enclosed in the corresponding Weibel's clamp of the opposite side and out through the vaginal fascia and vaginal wall. The first suture is now tied and this brings together the vaginal fascial and the post-urethral ligament, and draws down the peritoneum to stitch it to the post-urethral ligament. In this way an excellent support is obtained which tends to prevent the bladder from herniating again. As a result of the second suture a shelf is formed by the tissues of the upper part of the broad ligament which also prevents the bladder from herniating again.

Next if there has been a well marked enterocele the uterosacral ligaments are sutured directly to the post-urethral ligament and subsequently with a series of interrupted sutures it is possible to suture the two uterosacral ligaments together but this necessitates

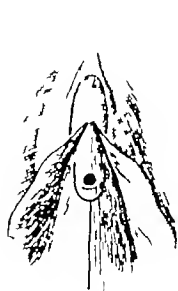


Fig. 19.

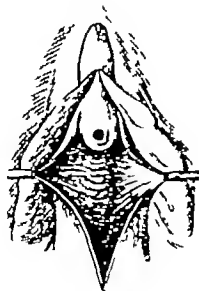


Fig. 20.

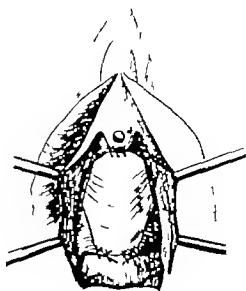


Fig. 21.

Fig. 19. Operation for stress incontinence. The incision is semicircular around the external meatus, with a prolongation upward in the midline along the anterior vaginal wall. The incision allows the lower part of the urethra to be mobilized.

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Fig. 21. The sling has been sutured in position. Above, one edge of the broad part of the sling has been sutured to the skin remaining around the urethral meatus. It is not advisable to introduce stitches into the wall of the urethra in this region. The other edge of the sling is sutured directly to the cranial margin of the post-urethral ligament. On each side the thin ends of the sling pierce the tissues lying lateral to the urethra.

making a longitudinal incision in the posterior vaginal wall from the opening in Douglas pouch otherwise the ligaments cannot be exposed sufficiently accurately (Fig. 17) The tissues contained in the other clamps are sutured together by the usual Mayo-Ward method and it is often expedient to delay this suturing until this stage of the operation has been reached.

#### OPERATIONS FOR STRESS INCONTINENCE

Vaginal operations for the relief of stress incontinence have one factor in common—the originators always claim good results. It is doubtful whether the Stoeckel Goebell technique or the more modern Aldridge method of sling operation should be employed unless efforts at vaginal repair have failed. I am quite satisfied that if the urethra is elongated in the methods I have described for anterior colporrhaphy, the Manchester Fothergill operation and vaginal hysterectomy the stress incontinence is usually relieved provided that the elongation is of a sufficient degree. Further more it is quite simple to interpose an additional supporting shelf beneath the urethra by a series of Lembert's sutures through the post

urethral ligament. Indeed, I have obtained better results by such methods than by the Kelly technique. The etiology of stress incontinence is obscure and I am convinced that there are many underlying etiological factors. Some of the worst cases result from anterior colporrhaphy when I believe the nerve supply to the voluntary urethral sphincter is divided. In the average case of stress incontinence the external meatus is patulous and prolapsed downward and forward and together with the lower  $\frac{1}{2}$  inch of the urethra projects well below the inferior pubic angle.

I think most gynecologists will agree that in a certain proportion of cases stress incontinence recurs after relatively simple vaginal operations. Moreover, the worst cases to deal with are those in which the symptom is present without accompanying cystocele or prolapse of the uterus. Often the only physical signs are a patulous external meatus combined with prolapse of the urethra and the lower third of the anterior vaginal wall. I have never been particularly impressed with the Stoeckel Goebell or the Aldridge operation mainly because the fascial strips which act as a sling are too narrow. I have therefore, attempted to

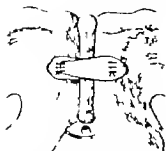


Fig. The ends of the sling sutured together in front of the symphysis pubis (diagrammatic). The lower end of the sling can be seen supporting the urethra.

correct the condition by interposing a strip of fascia lata between the anterior vaginal wall and the urethra and supporting the two ends of the strip by boring two holes in the pubic bones and suturing together the ends of the fascial strip in front of the symphysis pubis. The fascia lata strip is fashioned so that it has a broad middle piece which can be sutured in place in such a way that it lies along the whole length of the urethra. Moreover in some cases it may be convenient to suture the upper end of the strip to the front of the uterus itself. The operation details are as follows:

The strip must be 6 inches long and at least  $1\frac{1}{2}$  inches wide in its middle part tapering to ends which need not be more than  $\frac{1}{2}$  inch in width (Fig. 18). An open operation is required and the severed edges of the fascia lata are sutured together with continuous catgut sutures combined with a few supporting mattress sutures. The fascial strip can be obtained and the wound closed in not more than 15 minutes.

The next step is to incise the vaginal wall in the midline by an incision which starts a few millimeters above the level of the external meatus and extends upward (Fig. 19). At the lower end an incision is made around the urethra on each side in such a way that two lateral flaps can be dissected clear (Fig. 20). If there is an associated cystocele the incision must be carried upward to above the level of the bladder sulcus and the operation for anterior colporrhaphy performed in the usual way. If only a urethrocele is present it may not be possible to carry the incision so far upward. At this stage of the operation the object is to expose the urethra along the whole

of its length and the vaginal flaps must be dissected away laterally the dissection being carried well out to the region of the pubic rami. The fascial strip is now taken and one edge of its midportion is sutured directly to the vaginal skin of a few millimeters thickness which remains around the meatus (Fig. 21). The opposite edge of the broad part of the fascial strip is sutured to the front of the cervix if the patient has been treated by the anterior colporrhaphy technique which I have already described. If however the bladder does not prolapse the upper end of the broad part of the strip is sutured by a series of horizontal interrupted sutures to the upper limit of the postretrothral ligament. In this way a broad sheet of fascia lata is placed in position to support the urethra.

The next step is to make a vertical incision on each side of the lower third of the urethra through the postretrothral ligament and the underlying tissues until the retropubic space has been opened up.

The next part of the operation has as its object to bore a hole through each pubic bone about  $\frac{1}{2}$  inch from the midline of the symphysis pubis. Various methods have been employed to obtain a good exposure. It is possible to make an incision on each side along the groove immediately lateral to the labium majus  $\frac{1}{2}$  inch below the adductor longus tendon. This area is relatively bloodless. The labium majus is drawn inward and the pubic bone exposed by dissection and with the use of a rugine. The disadvantage of this method is that when the end of the fascia lata strip is drawn through the hole in the bone it must be sutured to the periosteum for it cannot be sutured to the opposite end so that the amount of tension on the sling is uncertain. Another method which I have employed has been to make an arched incision over the lower part of the symphysis pubis and the bodies of the pubic bones after first drawing the labia minora upward. The method gives a simple approach to the bones but it has certain grave disadvantages. In the first place, the urethra and the meatus tend to fall upward into the vagina when the patient is in the lithotomy position. Next the holes made in the bones are too low down so that the fascial sling is

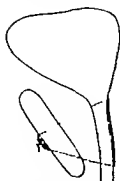


Fig. 23. Diagrammatic representation of the method of slinging up the urethra to the symphysis pubis. This illustration should be compared with the direction of the sling in the Aldridge operation. With the method illustrated there is no risk of kinking the urethra.

not supported in the correct direction. Another method is to make an arched incision with its upper limit at the level of the base of the clitoris which corresponds to about half way down the symphysis pubis, with the lateral vertical limbs of the arch, each at about  $1\frac{1}{2}$  inches from the midline. It is a simple procedure to find the correct layer between the tendinous structures attached to the bones and the superficial tissues of the mons. Venous hemorrhage is troublesome just as in a Pfannenstiel incision, and great care must be taken to ligature every vessel because of the risk of the development of a hematoma. Experience has shown that the most satisfactory of the three methods of approach is by means of the incisions lateral to the labia majora. Excellent results have been obtained and it does not seem to be of importance to gauge the amount of tension placed on the sling with very great accuracy. It seems necessary only to suture the ends of the sling to the periosteum and the tendinous structures attached to the bones. The bodies of the pubic bones are cleaned with a rugine and the bones are perforated about  $\frac{1}{2}$  to  $\frac{3}{4}$  inch from the midline with a simple brace and drill. An assistant can introduce a finger through the vagina into the retropubic space to prevent damage to the bladder. There seem to be no technical difficulties in drilling the bone and there seems to be little risk of damage to the bladder. One of the most difficult parts of the operation is to bring the ends of the fascial strip through the drill holes. A piece of catgut is tied to the end of the fascial strip and a long curved needle 3 inches in

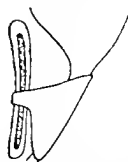


Fig. 24. The fascial sling is shown in position supporting the urethra, while to the left is the aperture through the pubic bone through which the end of the sling has been passed.

diameter is passed eye end first from in front through the drill hole then behind the pubic bone through the incision in the post urethral ligament and the catgut attached to the strip threaded through the eye of this needle. The needle must be of the correct size and have a full half circle curvature. The end of the strip can then be brought out through the front of the drill hole in front of the pubic bone. The two ends are then sutured together and the correct amount of tension obtained (Fig. 22). It is an extraordinary sight to see how the urethra can be pulled up to lie in the correct position. This part of the operation compares most favorably with the other methods of sling operation. With the other methods of approach a few sutures are introduced to attach the strip to the periosteum near the trephine hole. Penicillin powder is now introduced into the wound particularly near the trephine holes. The great objection to drilling the pubic bones is the theoretical risk of osteomyelitis although this complication did not develop in any of my cases. I felt therefore that the operation would be simplified if the end of the fascial strip were brought out through the lower angle of the obturator foramen. Much time was spent working with models and although I realize that the sling support is not so effective in direction when the ends are brought out through the obturator foramina I tried out the method in a few cases and obtained excellent results. At the present time I have abandoned the method of drilling the pubic bones except for what I regard as severe cases. In the method of bringing the ends of the sling through the obturator foramen vertical incisions are made on the

outer sides of the labia majora and the tissues are cut through down to the obturator foramen with a scalpel. A specially curved forceps with toothed ends is then passed through the obturator foramen in front and brought down lateral to the urethra as in the other methods and the end of the strip is sutured to the deep tendinous tissues in the vicinity of the obturator foramen. The operation is extremely simple to perform and the results obtained are satisfactory.

Up to the time of writing 25 patients have been operated upon and the end results have been extremely satisfactory. My own impression is that the results are already far better than those I have obtained with the Aldridge operation and the broad support of the sling is obviously theoretically correct.

The characteristic optimism of all originators of operations for stress incontinence has been discounted so far as possible. Fundamentally the idea behind the operation is to replace the posturethral ligament by the strip of fascia lata. Only time will show whether the fascia will produce a permanent support. The method has other possibilities for a wide sling might be used in the treatment of severe degrees of cystocele.

#### SUMMARY

1. The anatomical details of the grooves, rugosities and folds of the anterior vaginal wall have been described.

2. The anatomical relations of the endopelvic fascia in the vicinity of the anterior vaginal wall have been discussed.

3. A condensation of the endopelvic fascia behind the urethra has been described and the term posturethral ligament has been used to describe this band.

4. An attempt has been made to describe the operation of cystocele on a purely anatomical basis, and a method of suturing the posturethral ligament to the cervix has been described.

5. Details have been given of the method of using the posturethral ligament in the operation of vaginal hysterectomy for prolapse and in the Manchester Fothergill operation.

6. A new method of sling operation for stress incontinence has been described. It consists of utilizing a sheet of fascia lata as a sling behind the urethra and bringing the two ends together through holes bored through the pubic bones.

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## EXPERIMENTAL PULMONARY EMBOLISM

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**T**HIS experimental study was conceived with the object of determining whether or not pulmonopulmonary, pulmonovagal depressor and pulmonocoronary reflexes contributed to the death of animals subjected to massive pulmonary embolism. The literature is extensive on this subject and has been reviewed by Horn Dack and Friedberg in 1939 and Currens and Barnes in 1943. Reference will be made only to articles pertinent to the present study.

One of the principal objections to experimental studies on pulmonary embolism is that the embolus does not simulate that found in the human being. For anatomic and histologic observations of the pulmonary parenchyma, any foreign body that occludes pulmonary arteries may be used. Progressive thrombosis of the pulmonary arteries and retrograde thrombosis into the right ventricle following lodgment of emboli in the pulmonary arteries are not well understood and may be of considerable clinical importance. Thrombosis superimposed on an embolus cannot be satisfactorily studied in the experimental animal that has an artificial foreign body occluding a pulmonary artery. This objection has been minimized in the present study.

Another objection that has been raised is that the depth of anesthesia in experimental work of this nature precludes accurate observation of reflex changes. Care was taken to avoid deep anesthesia and in practically all the animals gentle manipulation of blood vessels in the periphery produced slight pseudo-affective responses.

Forty adult, healthy mongrel dogs weighing 7 to 15 kilograms were lightly anesthetized with sodium pentobarbital administered

intravenously. An endotracheal tube was inserted in those animals which were to have the thoracic cavity opened. A mechanical positive pressure respirator was attached to the tube. Both external iliac veins were exposed retroperitoneally up to the internal iliac veins. The common femoral veins were exposed and all branches ligated with No. 000 silk. Soft rubber bulldog clamps were applied to the external iliac veins just distal to the internal iliac veins. Five hundred units (0.5 c.c.) of thrombin were injected into each iliofemoral vein through a No. 27 needle. Five puncture sites were used on each side. Each vein was gently massaged two or three times to insure adequate mixing of the thrombin and blood. Within a few minutes a firm thrombus could be palpated through the wall of the vein. In the open chest preparation the left costal cartilages were cut and the thoracic cage spread apart until adequate exposure of the base of the heart was obtained. A metallic cannula was inserted into the left common carotid artery and connected to a calibrated mercury manometer which recorded partially dampened pressures on a kymograph. A brass cannula 15 centimeters in length was inserted into the right atrium through the left external jugular vein. A column of 0.25 per cent sodium citrate was connected to the cannula and to a recording device to determine venous pressure directly. An electrocardiograph recorded the conventional three leads in 11 animals. After basal records of the arterial and right atrial pressures were taken the clamps were simultaneously or consecutively removed from the iliac veins.

Twenty five animals were used in studying the dynamics of pulmonary embolism without nerve section or intravenous papaverine. Three were used to establish a satisfactory method of recording pressures. One died during insertion of the atrial cannula. Nine died

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within 5 minutes after release of the emboli. Twelve were sacrificed after apparently having recovered from the embolism. Of these 12 dogs 8 had emboli obstructing the main pulmonary arteries. Four had embolic obstruction of only one pulmonary artery. After release of the emboli the following characteristic sequence of events occurred. Within 2 to 5 seconds, the dog developed marked respiratory distress, a precipitous drop in arterial pressure, tachycardia, and an elevation in atrial pressure. In the dogs that succumbed the respiratory rate increased, became irregular and then slowed progressively during the ensuing few minutes. The depth of the respiratory excursion increased until only infrequent gasps were observed. During the same period the arterial pressure dropped progressively, the cardiac rate became slower and venous pressure rose several centimeters of water. In none of the 40 dogs was ventricular fibrillation or abrupt cessation of cardiac activity observed. Cardiac contractions became progressively slower and more feeble until all muscular activity ceased. Respirations invariably stopped in the closed chest preparations before cardiac contractions ceased. The initial stimulation of respiratory rate and depth can best be explained by the superior vena caval reflex described by Megibow, Katz and Feinstein. The cessation of respiration, however, before cardiac activity ceased, accompanied in all instances a progressive systemic hypotension and was probably a dependent upon cerebral ischemia. In the open chest preparations, dilatation of the pulmonary conus, right ventricle and atrium (Fig. 1) was striking in the dogs that did not survive. Distension of the coronary veins was noted.

The heart and lungs were examined immediately after death or sacrifice and sections taken whenever it was thought advisable. The right heart of all animals was dilated. The dilation, however, was less striking than in the living animal. The emboli were easily recognized and found consistently in the major pulmonary arteries (Fig. 1). On occasion embolic fragments were found caught in the chordae tendinae in the right ventricle and on 2 occasions embolic obstruction occurred at the tricuspid valve. The emboli were firm homo-

geneous and purplish-red. On many occasions recently formed thrombi were observed extending into branches of the pulmonary arteries. They were also found in the right ventricle. They differed from the emboli in that they were soft and bright red. The last 13 animals were heparinized with 10 milligrams of heparin given intravenously after the thrombi were formed in the iliac veins. It was our impression that the heparinized animals underwent less severe changes in pressure after embolism. Individual variation, however, was sufficiently great so that no exact statement can be made on this aspect of the experiment. Examination of the pulmonary arteries of the heparinized animals revealed the emboli to be farther out in the divisions of the main pulmonary artery than was seen in the nonheparinized animals. The formation of thrombi in the branches of the pulmonary arteries was conspicuously absent in these animals. The left atrium and ventricle, aorta and inferior vena cava were routinely opened and on no occasion was the blood coagulated. Contrary to the findings of Megibow, Katz and Feinstein, the lungs of the dogs that died within 2 to 10 minutes showed areas of atelectasis, and diffuse or focal ecchymosis. Figure 2 shows the two lungs of a dog that died 5 minutes after release of the emboli. Sections of the right and left lung are shown in Figures 3 and 4. Atelectasis, diapedesis of erythrocytes, and interalveolar hemorrhage are noted in Figure 4, whereas little change is observed in the lung that had only partial embolic obstruction of its artery (Fig. 3).

In the animals that survived the initial emboli characteristic changes occurred in their cardiovascular dynamics. Arterial pressure dropped immediately 20 to 40 millimeters of mercury and returned to the initial level or above within 5 seconds to 1 minute. Right atrial pressure rose 20 to 40 millimeters of water and gradually over a period of 2 to 3 minutes returned to normal (Fig. 5). Respiratory changes were variable in this group. In general the rate increased for a few seconds. The depth of respiration, however, increased or decreased and on occasion no change was noted.

In all but 1 of the experiments in which the animals survived the initial emboli the pres-

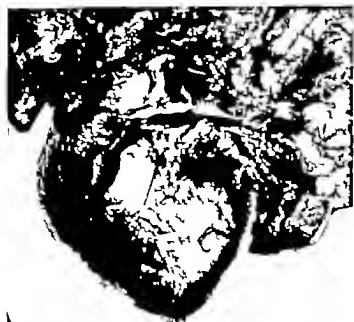


Fig 1. The pulmonary conus, right and left pulmonary arteries have been opened. Emboli lying in both pulmonary arteries can be seen. The right side of the heart is dilated and the distended coronary veins are seen.

sure in the right atrium promptly returned to normal levels. In view of this observation it is unlikely that reflex vasoconstriction of the pulmonary arterial tree occurs in sublethal embolism. The readjustment of blood volume in the pulmonary circuit and the response of the right ventricle to the increased pulmonary resistance explain more simply the rise and fall of right atrial pressure.

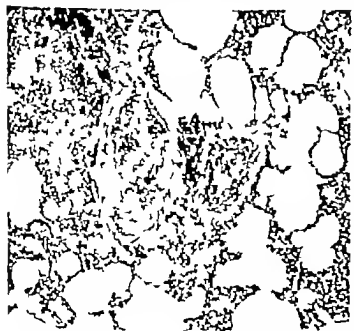


Fig 3. The microscopic appearance of the relatively normal lung in Figure 2.

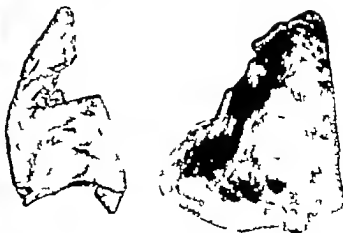


Fig 2. Cross appearance of the right and left lung 5 minutes after a fatal embolus. The pulmonary artery to the lung on the left was partly obstructed. The glistening surface may be seen. Complete obstruction was present on the right and the ecchymosis and loss of luster are noted.

One of the most impressive observations made on these 40 animals was the marked degree of obstruction in the pulmonary arteries necessary to produce death. In many of the dogs that were sacrificed a large part of the pulmonary circuit was obstructed and yet dynamic changes during the embolism had been slight and temporary. In these animals however there was reason to believe that with

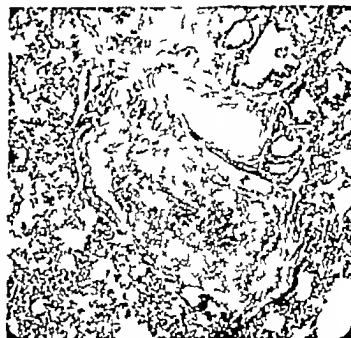


Fig 4. The microscopic appearance of the lung whose pulmonary artery was completely obstructed (Fig 2). Atelectasis and interalveolar hemorrhage are noted. A branch of the pulmonary artery containing an embolus can also be seen.



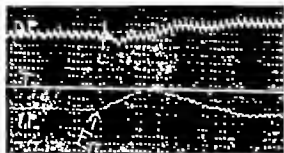


Fig. 5 The top record indicates left carotid blood pressure, the center I time in seconds and the lower right trial pressure. E designates the release of the thrombus from the iliac veins. The fall in carotid pressure and the rise in atrial pressure were found in all animals.

superimposed thrombosis, death would have ultimately intervened.

Electrocardiographic tracings in 11 experiments showed no consistent alteration in pattern. Depression of the S-T segment in lead III was encountered in 6 dogs. Inverted and diphasic T waves were seen in lead III on 5 occasions. Prominent Q waves were observed 3 times in leads I and III. A shifting pacemaker was observed once and arteriovenous dissociation once. In fatal instances gradual slowing of the auricular rate was seen. No ventricular fibrillation was recorded.

For many years a controversy has existed concerning the presence or absence of pulmonovagal reflexes in pulmonary embolism. Schwiegk, Schweitzer and Parin observed that distension of the pulmonary arteries produced a reduction of systemic arterial pressure that was abolished by section of the cervical vagi. Parin suggested that the systemic hypotension not uncommonly observed in pulmonary embolism may be due to such reflex activity. A pulmonovagal-coronary reflex reducing coronary blood flow has never been demonstrated experimentally but has been invoked on many occasions to explain death in pulmonary embolism. The suggestion that a pulmonocoronary reflex exists in pulmonary embolism is based in part on clinical evidence. Leriche, Fontaine and Friedmann reported 30 per cent of their patients who died after pulmonary embolism had only partial occlusion of the pulmonary arteries. De Takats, Beck and Fenn noted that a typical death from pulmonary embolism occurred in the pres-

ence of minor pulmonary obstruction in 7 out of 35 cases. On the other hand, Pilcher in a postmortem study of 40 patients who died following pulmonary embolism observed mechanical obstruction sufficient to cause death in 37. Karsner has never observed death as a result of a minor embolism without some contributing cause being present such as cardiac failure or coronary arteriosclerosis. Horn, Dack and Friedberg observed that morphologic evidence of coronary insufficiency in cases of embolism of the pulmonary artery is more likely to occur if there are recurrent embolization, narrowing of the coronary arteries, cardiac hypertrophy and adequate duration of life after embolism.

The experimental evidence in favor of a pulmonocoronary reflex has resulted from survival studies after cervical vagotomy and atropinization. Electrocardiographic studies before and after vagotomy and atropinization in pulmonary embolism have also contributed to the acceptance of such a reflex. Mosler, Radnai and Mosonyi and Scherf and Schonbrunner after studying electrocardiographic changes in pulmonary embolism and the results of vagal section and atropinization concluded that vagal stimulation had decreased coronary blood flow. Love, Brugler and Winslow felt that similar electrocardiographic changes could be ascribed to mechanical obstruction of the pulmonary circuit. Mallinow, Katz and Kondo stated that bilateral cervical vagotomy did not abolish the electrocardiographic alteration produced by emboli in dogs and that there was no evidence for assuming the existence of a pulmonocoronary constricting reflex in pulmonary embolism. De Takats, Beck and Fenn observed a 33 per cent mortality with atropine and 60 per cent with vagotomy in dogs which were subjected to embolism. A control series had a 100 per cent mortality rate.

Experimental work has demonstrated that mechanical obstruction of the pulmonary circuit is necessary to produce death. Mann introduced paraffin and blood clots formed *in vitro* into the venous circulation and found that death occurred only in the presence of considerable obstruction to pulmonary blood flow. Hall and Ettlinger concluded that re-

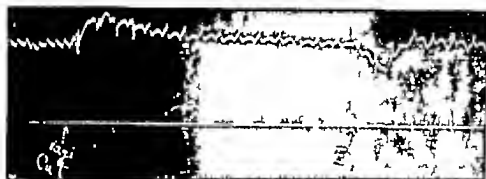


Fig 6 The upper pressure recording is the carotid blood pressure and the lower the right atrial. Cervical vagotomies were performed as indicated on the graph. The emboli were released at  $E_1$ . The same changes in pressures were observed. Tachypnea did not develop.

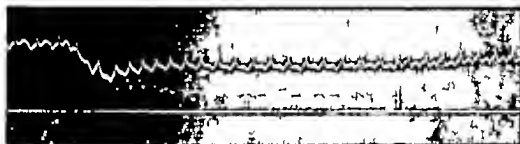


Fig 7 This is a continuation of the record in Figure 6. At  $E_2$  emboli were released. Seventy five per cent of the pulmonary arterial circuit was occluded at autopsy.

flexes did not contribute to death in experimental embolism. Mendlowitz using a Pen rose tube filled with dilute barium sulfate studied cardiac dynamics after a major embolism in dogs and concluded that the type of circulatory failure resulting was due only to mechanical obstruction of blood flow in the pulmonary circuit.

Eight dogs were subjected to cervical vagotomies and 4 dogs had resections of the stellate and upper four thoracic ganglia as well as vagotomies. Changes in hemodynamics were consistent and precisely what were encountered in the control experiments. Arterial pressures were reduced as rapidly and extensively as before. In the dogs that survived the initial emboli arterial pressures returned to normal within 1 to 2 minutes. Changes and readjustments in right atrial pressure similar to those in the control animals were observed in this group. No more emboli were required to produce death than in the control series.

**Protocol 32:** A 15 kilogram dog was anesthetized with intravenous nembutal and an endotracheal tube inserted to insure a free respiratory passageway. The thoracic cavity was closed throughout the experi-

ment. Left carotid and right atrial pressures were recorded as previously described. The pulse and respiratory rate were recorded. A three lead electrocardiogram was taken before and during the experiment. The external iliac veins were exposed retroperitoneally up to the common iliac veins. All branches of the external iliac and common femoral veins were ligated. Five hundred units of thrombin were injected into each common femoral and external iliac vein at 5 sites through a No. 27 gauge needle. The cervical vagi were exposed and sectioned. Figure 6 shows the result of the vagotomy and the pressure changes observed after release of the first emboli. Arterial pressure dropped 40 millimeters of mercury. A slight temporary reduction in pulse pressure was observed. Venous pressure rose 25 millimeters of water and the depth of respiratory excursions increased. The dog recovered within 2 minutes. Ten minutes later a second embolus was released. The same change in dynamics occurred except several minutes transpired before recovery was complete (Fig 7). A third embolus was released with similar alterations in pressures observed following which the animal was sacrificed by injecting 10 cubic centimeters of nembutal intravenously. The thoracic viscera were examined. Multiple areas of ecchymosis and atelectasis were observed in all lobes of the lungs. The right heart was dilated and coronary veins distended. On opening the heart the left ventricle and atrium contained a small amount of bright red blood. The right pulmonary artery was obstructed by a large embolus. The left pulmonary



Fig. 8. Both vagal and upper thoracic sympathetic chains are removed. The emboli are released (F). The upper record shows the profound drop in carotid pressure. The lower record is right atrial pressure.

artery contained an embolus which occluded no more than 50 per cent of its lumen. An embolus was lodged between chordae tendinae in the right ventricle.

**Protocol 30.** This animal was prepared as all others. In addition however the cervical vagal, stellate ganglia and thoracic sympathetic chains (T<sub>2</sub> to T<sub>5</sub>) were removed. The thoracic cavity was then closed while positive pressure was applied to the respiratory tract through an endotracheal tube. Figure 8 shows the immediate reduction in arterial pressure and rise in venous pressure with death ensuing 3 minutes after release of the embolus. Obstruction of both pulmonary arteries was found at autopsy.

Dog 38 was subjected to both bilateral vagotomies and cervicothoracic sympathectomies. After release of the emboli, arterial pressure fell and venous pressure rose transiently in the same manner was observed in the control animal.

Papaverine has been enthusiastically advocated in the treatment of pulmonary embolism. The use of this drug is based on the well known clinical and experimental observation that embolic obstruction of a peripheral artery induces in many instances an intense spasm of the arterial tree of the extremity both distal and occasionally proximal to the site of obstruction. It is also well established that papaverine relaxes smooth muscle (Pal) and produces vasodilatation (Macht 16 and Macht Herman and Levy 17). From these facts it has been postulated that a pulmonopulmonary vasoconstricting reflex occurs in pulmonary embolism and that it may be advantageously abolished by the administration of papaverine. Collins de Takats, Denk, Burk, Domanig, Katz and Barnes have advised the use of papaverine to relax the pulmonary arterial system. Jesser and de Takats in an experimental study showed that the vascularity of the pul-

monary arterial tree increased after the intravenous administration of papaverine immediately following embolism of a major artery. No conclusions could be drawn however as to the presence of arteriospasm before the use of papaverine or arteriodilatation afterward. In a series of 10 dogs subjected to massive embolism and given papaverine they obtained a mortality rate of 40 per cent whereas a control group of 25 all succumbed. Bradshaw and Chodoff studied the effect of eupaverine on the pulmonary circulation of 20 cats. Transient depression of the systemic pressure and transient elevation of the pulmonary pressure were consistently found. After embolization with oil similar but greater changes occurred.

Three dogs were given papaverine intravenously before and after embolization in doses ranging from 0.0032 to 0.016 gram. Similar changes were observed in the 3 experiments. Dog 34 was given 0.0032 gram of papaverine intravenously. The systemic arterial pressure fell abruptly but returned to normal levels within 20 seconds. The decrease in atrial pressure was observed on several other occasions and is not in accord with Bradshaw and Chodoff's observations. The most striking feature of all papaverine injection however was the transient nature of the effects on the cardiovascular system. Figure 9 shows the result of administering 0.0032 gram of papaverine im-



Fig. 9. An embolus is released (F). The reduction in carotid pressure (upper) and elevation of right atrial pressure (lower) are seen. 0.0032 gram of papaverine is administered intravenously and secondary drop of carotid pressure is noted. The temporary interruption of the rising right atrial pressure is seen also.

mediately after release of emboli. A temporary reduction of atrial pressure occurred but it was immediately followed by a persistent elevation. This same dog was subsequently given 0.016 gram of papaverine intravenously with the characteristic depression of both carotid and right atrial pressures (Fig. 10). At autopsy it was estimated that 90 per cent of the pulmonary arterial circuit was obstructed with emboli in the main pulmonary arteries. Atelectasis and ecchymotic areas were observed in all lobes except the right lower.

Dog 35 was given 0.0064 gram of papaverine intravenously and displayed a reduction in systemic pressure of 40 millimeters of mercury but no change in atrial pressure. Thirty seconds later emboli were released and the customary changes in pressures were observed. After stabilization of the pressures had occurred the experiment was repeated with the same results. Papaverine given 2 minutes after recovery produced depressions of carotid pressure and right atrial pressure which returned to normal in 30 seconds. After pressures had become stabilized embolization was repeated followed by papaverine in 2 minutes. Again reductions in arterial and atrial pressures were observed. At autopsy a saddle embolus was found with moderate patchy atelectasis and intrapulmonary hemorrhage.

#### DISCUSSION

It cannot be denied that deleterious reflexes may contribute to death in pulmonary embolism in the human being. It would indeed be strange if autonomic reflex activity did not increase when a large portion of the pulmonary circuit is suddenly obstructed.

Our experimental findings do not support such a view but are more in accord with the conclusions of Hall and Ettinger and Mendlowitz. In the 40 dogs studied in this series no hemodynamic changes were observed that could not best be explained on a mechanical basis. Depending upon the amount of pulmonary obstruction systemic arterial pressure fell moderately or slightly and recovered promptly as blood flow through the unobstructed portion of the pulmonary circuit increased. As obstruction became more complete systemic pressure fell progressively un-

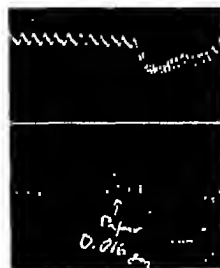


Fig. 10. This record is a continuation of Figure 9. 0.016 gram of papaverine administered intravenously temporarily depressed both carotid and right atrial pressures.

til death occurred. Pressure in the right atrium rose in a fashion corresponding to the depression in arterial pressure. No dogs died suddenly suggesting coronary artery spasm. All the dogs who were subjected to vagal section and removal of the stellate and upper thoracic sympathetic ganglia exhibited the same dynamic changes as the control group.

Our experience is in accord with Katz's suggestion that electrocardiographic patterns suggesting coronary insufficiency are the result of a combination of reduced aortic pressure and increased pressure in the right heart interfering with venous drainage from the myocardium.

So far as a pulmonopulmonary reflex is concerned there is no evidence in this study that such exists. In all instances of embolism whether the vagi and sympathetic chains are intact or not the changes in systemic and right heart pressures are transient if the dogs survive and are readily explained on a basis of mechanical readjustment of pulmonary circulation. In the animals that succumb systemic pressure becomes progressively lower and right atrial pressure higher. These animals all have at least 70 per cent of the pulmonary circuit mechanically obstructed. On no occasion was a persistent elevation of right atrial pressure observed which could be explained on a basis of pulmonary arterial spasm.

The reduction of right atrial pressure after the administration of papaverine could be in

terpreted as being the result of relaxation of the pulmonary arterial tree. It could be associated as well with relaxation of the venae cavae entering the heart. The simultaneous depression of atrial and arterial pressures after giving papaverine and their concomitant recovery are more indicative of a generalized arterial and venous dilatation than relief of a localized pulmonary arteriospasm. If the temporary reduction in atrial pressure were due to pulmonary arterial dilatation an increased filling of the left heart and rise of systemic pressure could be anticipated. This was not seen.

A patient was recently observed by one of us who was apparently recovering from the initial hypotension produced by a large pulmonary embolus. Immediately after the intravenous administration of 0.032 gram of papaverine the blood pressure dropped, pulse rate dyspnea, and cyanosis increased for a period of 2 to 3 minutes. The patient recovered and no opportunity for determining the occurrence of a second embolus was possible. It was considered likely that the dramatic clinical changes resulted from the administration of the papaverine.

In view of the consistent reduction in arterial pressure observed in all experimental studies after papaverine has been administered any benefits derived from the use of this drug in major pulmonary embolism appear doubtful. All of the animals that died in these experiments did so in a state of marked hypotension. Respirations ceased in all instances before cardiac activity was arrested. To embarrass further the circulation to medullary centers by depressing systemic blood pressure does not seem warranted. If the administrations of papaverine were of value its transient effect would exclude any therapeutic benefit.

#### CONCLUSIONS

1. Pulmonary embolism closely simulating that occurring in human beings was produced experimentally.

2. No evidence was obtained from these experiments to support the supposition that pul-

monopulmonary pulmonocoronary or pul-monovagal depressor reflexes contribute to the death of dogs after massive pulmonary embolism.

3. It is suggested as a result of this work that the use of papaverine in the treatment of massive pulmonary embolism is without benefit and may indeed be harmful.

4. The constant absence of postembolic thrombosis in the pulmonary arteries of the heparinized animals suggests that the early intravenous administration of heparin to patients may be of great value.

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# THE NATURE OF LATERAL "ABERRANT" THYROID TUMORS

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A CONTROVERSY has existed for many years concerning tumors of thyroid tissue in the lateral regions of the neck. In the earliest reports of these tumors the opinion was held that they represented neoplasia of aberrant thyroid tissue. But the association of lateral cervical tumors with neoplasm of similar structure within the thyroid gland in many if not in all the cases has recently led to the opinion that they represent secondary rather than primary growths. From the evidence adduced at the present time it is clear that lateral thyroid tumors must be appraised in relation to tumors of the main thyroid gland. There are three possibilities to consider (1) lateral thyroid tumors originate in thyroid tissue which is separated from the thyroid gland by defective embryogenesis and in the majority of cases metastasize to the thyroid (2) tumors in thyroid and aberrant thyroid tissue represent multicentric neoplastic growth in a single type of embryonal rest (3) they are early metastases from a tumor of the thyroid gland and become clinically apparent before the tumor of the thyroid manifests itself.

It is the purpose of this paper to determine what features connected with the growth of these tumors can be considered as evidence for one or another mode of origin. For this purpose we shall present an analysis of all the lateral thyroid tumors received in the laboratory of the New England Deaconess Hospital over a period of 19 years.

## MATERIAL

There were 63 cases diagnosed as lateral aberrant thyroid tumor among approximately 20,000 surgically removed thyroids in a 19 year period, an incidence of slightly more than

0.3 per cent. This series also represents 3.9 per cent of 1,610 benign and malignant thyroid tumors in the surgical material. Selection of cases was determined by the clinical or pathological diagnosis. The clinical diagnosis was made on the observation that a lateral mass or masses was palpable while the thyroid gland was and remained clinically negative that the lateral mass was larger than any nodule felt in the thyroid gland or lastly that a cervical mass was present before the thyroid was noticeably affected. Occasionally the diagnosis was based on the microscopic findings by the pathology department.

In 57 cases the clinical diagnosis of lateral thyroid tumor was confirmed by the histological examination. There were 6 remaining cases which were not confirmed by microscopy. Of these latter 2 were metastatic tumors unrelated to thyroid tissue; they were single nodules of cancer present in the lateral side of the neck. In 4 cases colloid adenomatous thyroid tissue unconnected with the thyroid gland was present. Two of these patients had been operated upon elsewhere 1½ and 30 years previously following which adenomatous tissue developed in an aberrant site. A third had cancer of the lung for which a biopsy of a single cervical nodule was performed and this proved to be colloid adenomatous thyroid tissue. His thyroid was not investigated. The fourth was a woman with goiter of 17 years duration who had a small mass in the left supraclavicular area near to but unconnected with an enlarged non neoplastic adenomatous left lobe.

The observations to be made in the following are concerned primarily with the 57 cases.

## OBSERVATIONS

*Clinical.* Table I shows the age distribution of the series.

The data reveal a predominance of women in a ratio of a little more than 2 to 1 with an

From the Laboratory of Pathology, New England Deaconess and New England Baptist Hospital and the Harvard Cancer Clinic.

Most of the surgical material reported in this paper came from the surgical service of the Luby Clinic.

TABLE 1 — AGE DISTRIBUTION

Age years	N	Sex
30	3	
30	20	
4 30	3	
5 60	7	
6 70		

1 females 30 Males 8  
h.a. 2-62 years

TABLE II—DURATION OF HISTORY BEFORE TREATMENT AT THIS HOSPITAL.

More	N	Less
Less than		5
5-5		8
5		
Over 5		
Not stated		6

average at admission for the entire series of 347 years. In the general thyroid material at this institution the ratio of women to men is 4:1 and the average age at admission of the surgical thyroid patient is 43.0 years  $7\frac{1}{2}$  years more than the average of this series. Almost two-thirds of the patients of this series are below the age of 40.

Table II presents the pretreatment interval. Here it is worthy of mention that a patient waited on the average almost 4 years (average duration 3.9 years) before seeking treatment and that 3 patients had histories of over 10 years. No correlation between the age of the patient and the duration of the history was disclosed.

The majority of patients had but one complaint a lump nodule or swelling in the neck which gradually enlarged. Forty three of the 57 patients offered this as a primary symptom and of these 37 had no other symptoms. In 4 instances the presence of a cervical mass was not noted by the patient and was discovered by the examining physician. Other symptoms consisted of a pressing or choking sensation fatigue dyspnea, local pain or tenderness. Signs rarely found were weight loss and voice change. When secondary symptoms and signs were present they usually occurred several weeks or months before the patient sought medical aid and were effective in forcing patient to find relief.

TABLE III — CLASSIFICATION OF LATERAL  
MASSSES CLINICALLY REGARDED AS ABER-  
RANT THYROID

Number answers not identified as numbers	Numbers containing number	Negative numbers
	—	—
	—	—
	—	—
	—	—
	—	—
	—	—
	—	—
	—	—
3	—	—
4	—	—
4	—	—
6	—	—
6	—	—
	—	—
4	4	—
		3
3	3	4
		5
	3	3
3	3	5
4	3	6
6	4	—
		—
	5	—
	—	—
	—	—
	—	2
	—	—
	—	—
	—	—
	—	4
	—	5
	—	4
4	—	3
6	—	—
	3	6
	3	6
	4	3
		0

BILATERAL CERVICAL MASSES

Tumor masses not identifiable as nodules	Nodules containing tumor	Negative nodules
Right	—	—
Left	—	—
Right	—	—
Left	—	—
Right	—	—
Left	—	—
Right 4	—	—
Left 8	—	—
Right	—	3
Left	4	—
Right 3	3	—
Left 2	2	—

TABLE III—Continued

Tumor masses not identifiable as nodes	Nodes containing tumor	Negative nodes
Right 7	1	6
Left 2	—	4
Not separated as to side —	—	8

None of the patients had thyrotoxicosis. Two patients at the time of hospital entry had an elevated basal metabolic rate but displayed no other objective manifestations of a hyperfunctioning thyroid.

*The lateral cervical masses.* The lateral cervical masses which were excised and which were regarded clinically as aberrant thyroid tumors turned out to be one or more of the following: (1) neoplasm of thyroid tissue; (2) lymph node or nodes partially replaced by tumor; (3) negative lymph nodes. The histologic criteria of lymph nodes, especially those that were almost completely replaced by tumor, were a fibrous capsule, peripheral lymphoid follicles with germinal centers and sinuses (Figs 1, 2, 3). This combination of capsule, follicles, and sinuses was not seen in any of the tumors of the thyroid gland nor has it been found in other diseased thyroids except Hashimoto's struma along the capsular margin of the gland.

There were 17 cases in which the lateral masses microscopically consisted only of tu-

Fig. 1. Lymph node partially replaced by tumor.  $\times 30$ .

mor. In these instances the extirpated tumors showed no evidence of nodal structure in any portion nor was there any evidence as to their source, i.e., whether they arose from embryonal rests or from negative thyroid tissue. The number isolated in the laboratory ranged from 1 to 12 (Table III). In short, if the lateral tumors in these cases originated from defective embryogenesis or from a metastasis from the thyroid, there were no histologic findings to prove either derivation.

In 4 cases the lateral masses consisted of

Fig. 2. Lymph node partially replaced by tumor.  $\times 20$ .



TABLE I — AGE DISTRIBUTION

Age years	No. cases
30	3
30	20
3 40	3
4 40	
51-60	7
6 70	
1 females 30 31 les 3	
Range 7-6 years	

TABLE II — DURATION OF HISTORY BEFORE TREATMENT AT THIS HOSPITAL

Years	No. cases
Less than	3
3	5
3-5	8
6-	
5	2
Over 5	4
Not stated	6

average at admission for the entire series of 347 years. In the general thyroid material at this institution the ratio of women to men is 4:1 and the average age at admission of the surgical thyroid patient is 43.0 years  $7\frac{1}{2}$  years more than the average of this series. Almost two-thirds of the patients of this series are below the age of 40.

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TABLE III — CLASSIFICATION OF LATERAL MASSES CLINICALLY REGARDED AS ABERRANT THYROID

Tumor masses not identifiable as nodules	Nodules containing tumor	Negative nodes
1	—	—
2	—	—
3	—	—
4	—	—
4	—	—
6	—	—
6	—	—
2	1	—
	2	—
4	2	—
	4	—
	3	3
		4
3	3	5
4	1	3
6	3	6
	4	—
	1	—
	5	—
	—	—
	—	—
	—	—
	—	—
	—	4
	—	5
	—	4
4	—	3
6	—	—
	3	6
	3	6
	4	3
		10

BILATERAL CERVICAL MASSES

Tumor masses not identifiable as nodules	Nodules containing tumor	Negative nodes
Right	—	—
Left	—	—
Right	—	—
Left	—	—
Right	—	—
Left	—	—
Right	—	—
Left	—	—
Right	4	—
Left	8	—
Right	2	3
Left	4	—
Right	3	—
Left	3	—



Fig. 6. Thyroid tumor.  $\times 75$ .

that in 45 of the 57 cases cervical masses were lymph nodes or containing tumor tissue when the material was examined, that there were no gradations existing ranging from lymph nodes to partially replaced masses which could not be distinguished as nodal tissue.

The number of lateral masses was variable, from 0.5 centimeter in diameter to 5 centimeters in diameter. There was no relation between the number and size of lymph nodes containing tumor or their duration in the neck as determined by roentgen ray.

The location of the cervical masses was variable. They were seen most frequently extending from mastoid process and they were also anterior to the sternocleidomastoid muscle, posterior to the sternocleidomastoid muscle, lateral to the sternocleidomastoid muscle, and at the angle of the neck. They were on the right side 23 times, bilateral 11 times, and on the left side 23 times. Bilateral position not stated 3 times. In 11 cases studied histologically the tumor was as follows: malignant papillary carcinoma in 33, adenocarcinoma in 14,



Fig. 7. Area of adenocarcinoma of thyroid tumor. Same case as shown in Figure 6.  $\times 5$ .

papillary adenocarcinoma in 6 and carcinoma simplex in 4.

*The thyroid gland.* In 49 cases the thyroid gland contained a tumor. In every instance



Fig. 8. Area of carcinoma simplex of thyroid tumor. Same case as shown in Figure 6.  $\times 5$ .



Fig. 3. Lymph node with lymphatic invasion by tumor.  $\times 20$ .

both tumor masses and lymph nodes containing tumor. There were 12 cases in which the cervical masses were tumor nodules, lymph nodes partially replaced by tumor, and negative lymph nodes. There were 4 cases in which the masses were only lymph nodes containing tumor, 14 cases in which the masses were both tumor and negative lymph nodes, 4 cases in which the masses were lymph nodes, either partially replaced by tumor or uninvolved

and 1 case in which the masses received in the laboratory were merely negative lymph nodes. This last patient had had a previous operation elsewhere with removal of a lateral mass and the diagnosis of thyroid neoplasm was confirmed in this laboratory by examination of the slides (Case 5).

Table III is a tabulation of these data and shows the pathology of the lateral cervical masses.

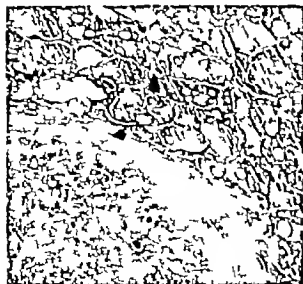


Fig. 4. Nodule of adenocarcinoma of thyroid gland.  $\times 30$ .



Fig. 5. Malignant papillary cystadenoma in lateral cervical mass. Same case as shown in Figure 4.  $\times 75$ .



Fig 6. Papillary area of thyroid tumor  $\times 75$

Table III reveals that in 45 of the 57 cases some of the lateral cervical masses were lymph nodes either uninvolved or containing tumor. It was apparent also when the material was examined microscopically that there were many cases in which gradations existed ranging from negative lymph nodes to partially replaced nodes to masses which could not be certainly recognized as nodal tissue.

The average number of lateral masses was six. Their size ranged from 0.5 centimeter in diameter to 8 centimeters in diameter, most being about 1.5 centimeters in diameter. There was no correlation between the number and size of tumor masses or lymph nodes containing tumor and their duration in the neck as disclosed by history.

The location of the cervical masses was variable and widespread. They were seen most often as a chain extending from mastoid process to clavicle but they were also anterior to the sternocleidomastoid muscle, posterior to the sternocleidomastoid muscle, lateral to the great vessels of the neck, in the submaxillary triangle, subinternally, and at the angle of the jaw as a single tumor. They were on the right side 23 times, on the left side 23 times, bilateral 8 times, and position not stated 3 times.

In the 57 cases studied histologically, the diagnoses were as follows: malignant papillary cystadenoma in 33, adenocarcinoma in 14,

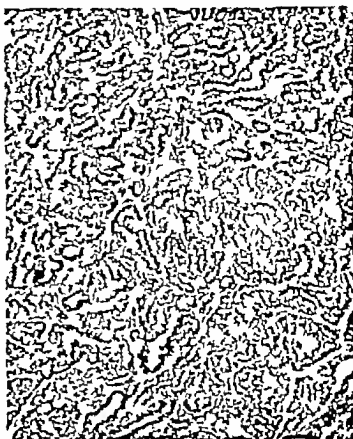


Fig 7. Area of adenocarcinoma of thyroid tumor. Same case as shown in Figure 6  $\times 75$

papillary adenocarcinoma in 6, and carcinoma simplex in 4.

*The thyroid gland.* In 49 cases the thyroid gland contained a tumor. In every instance



Fig 8. Area of carcinoma simplex of thyroid tumor. Same case as shown in Figures 6 and 7  $\times 75$



Fig. 9. Typical malignant papillary cystadenoma.  $\times 30$

the thyroid neoplasm was malignant and in all but 1 case was histologically identical with the lateral masses. In this latter patient there was an adenocarcinoma of the thyroid gland while the cervical masses presented a malignant papillary cystadenoma (Figs. 4 and 5).

There were 8 cases of the 57 in which a cancer of the thyroid was not found. Of these the glands of 4 patients were not removed having been regarded as negative at operation. In the remaining 4 cases the thyroids had been previously removed elsewhere and were not available for study.

Almost 15 per cent of the series were clinically free of thyroid disease though neoplasm was revealed at operation or in the laboratory. At the physical examination the thyroid was stated to be negative in 5 instances yet at operation a neoplasm was found larger than 1 centimeter in diameter. In 3 cases the gland was neither mentioned nor described in the history and a tumor was disclosed at operation. There was 1 case in which the thyroid after palpation at operation was stated to be negative. A tumor however less than 0.5 centimeter in diameter was discovered in the pathological laboratory. This was the only time a tumor was found in the thyroid less than 1 centimeter in diameter.

Precise anatomical location of the neoplasm in the thyroid was described in 18 cases. A

superior pole alone was involved in 7 cases. An inferior pole alone was involved in 5 cases. A single discrete nodule was present in both lobes or in one lobe and the isthmus in 4 instances. And in 1 patient there were two distinct tumor nodules in a single lobe. The remaining 31 patients were either not examined for location of the neoplasm or were diffusely affected throughout one or both lobes.

A comparison between the size of the thyroid tumor and the size of the lateral masses could not be made for in many instances the thyroid malignancy was not carefully measured. There were, nevertheless, at least 4 cases in which a single cervical mass was known to be larger than the tumor in the thyroid. In 41 cases in which there was a neoplasm of one lobe the affected lobe and the lateral cervical masses were on the same side. There were 7 instances in which both lobes contained a neoplasm and 1 instance in which a lobe and the isthmus were involved. In these latter cases there were bilateral cervical masses present.

**Histology** The histology of the lateral masses and thyroid tumors was quite pleomorphic, but except for 1 case the neoplasms in the thyroid gland and the lateral masses were histologically identical. Table IV lists the microscopic classification of the tumors, including the 8 cases in which only the lateral masses were available.

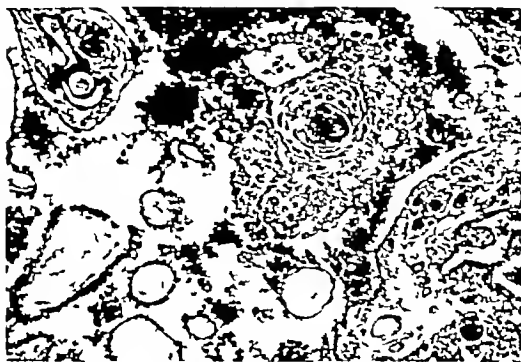


Fig 10 Squamous metaplasia in malignant papillary cystadenoma. X120

These diagnoses were based on the predominant pattern of growth revealed in microscopic section. The patterns were markedly variable (Figs 6 7 8). In almost every instance individual microscopic fields could be found which showed negative-appearing follicles fetal thyroid tissue complex arborescent fronds adenocarcinoma and carcinoma simplex. Generally however a single pattern predominated and this was usually of a papillary nature (Figs 9 and 10). Thirteen of the 14 cases of adenocarcinoma exhibited scattered minute regions of papillary structure. For the most part the neoplasms were well differentiated showing slight to moderate neoplasia and rare mitoses. Calcific concretions were seen 53 times being present in all tumors of the first three classifications. Ossification was present in 1 malignant papillary cystadenoma (Fig 11). In 2 instances the neoplastic tissue deviated so little cytologically from the normal that malignancy would not be suspected except for the fact that thyroid acini formed tu-

mor emboli in one (Fig 12) and were in the corium of the skin in the other case.

The cytological changes of malignancy were frequently difficult to evaluate for epithelial alteration was often slight. But generally the epithelium showed definite recognizable differences from the epithelium of normal hyperplastic or nodular goitrous thyroid. When found the changes were the same as those which characterize malignancy anywhere else in the body.

More obvious than the cytologic changes were the invasive properties. The latter included blood vessel lymphatic and invasion of surrounding tissue. True intravascular invasion was accepted only if thyroid epithelium formed part of a thrombus or embolus within a fibromuscular wall lined with endothelium and having an elastic lamina or if the

TABLE IV — MICROSCOPIC CLASSIFICATION

	Lateral masses and thyroid	Lateral masses only
Malignant papillary cystadenoma	29	4
Adenocarcinoma	11	3
Papillary adenocarcinoma	5	1
Carcinoma simplex	4	0

TABLE V — TYPES OF INVASION

	P papillary cyst adenoma	Adenocarcinoma	P papillary adenocarcinoma	C carcinoma simplex
Blood vessel invasion with or without lymphatic or simple invasion	—	—	4	—
Lymphatic invasion with or without simple invasion	4	—	—	—
Invasion of adjacent tissue	—	—	—	—



Fig. Ossification in malignant papillary cystadenoma.  $\times 30$



Fig. Blood vessel invasion. Not negative-appearing thyroid follicles and lack of cytological alteration.  $\times 75$

epithelium was attached to such a wall (Fig. 13). Lymphatic invasion was represented by the presence of tumor within at least three endothelial-lined spaces at a distance from the cut edge of the section (Fig. 14). Invasion of adjacent tissue was considered present if there was actual infiltration of capsule of negative-appearing thyroid parenchyma or of both (Fig. 15).

With these criteria it was found that the 49 cases in which the thyroid was available showed

one or more of the above invasive properties in the sections taken from the thyroid tumor. Occasionally the lateral neoplasms of these cases exhibited intravascular or lymphatic infiltration but this was noted less frequently than in the material from the thyroid gland. The data are given in Table V.

There were 8 patients from whom only the lateral cervical masses were resected. The thyroid was removed elsewhere in 4 instances and in 4 instances no resection was done be-

Fig 13. Blood vessel invasion.  $\times 75$ .

cause the gland was negative at operation. In 5 of these 8 cases the lateral masses showed invasive characteristics and were either lymph nodes partially replaced or solely tumor tissue not identifiable as being in lymph nodes. In 2 cases no invasive features were exhibited and the masses consisted entirely of neoplastic tissue. In the last case the cervical masses were 8 negative lymph nodes, no tumor being present (Case 5).

*Outcome.* Follow up observations are not available for most of the patients. For 9 there are partial data concerning outcome of treat-

ment. Of these there were local recurrences in 8 patients with subsequent death of 1. The ninth patient with a malignant papillary cyst adenoma was admitted to the hospital for cardiovascular renal disease 10 years after a radical neck dissection. At this time he was clinically free of thyroid malignancy. The patient who died suffered four local recurrences over a period of 11 years and finally succumbed following a craniotomy for removal of thyroid metastases to skull and brain (Fig 16). Her tumor at first cytologically resembled negative-appearing thyroid tissue (mentioned before

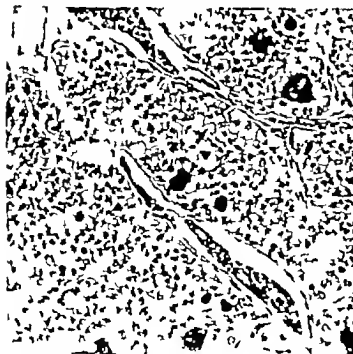
Fig 14. Lymphatic invasion present at a distance from cut edge of the section.  $\times 180$ .Fig 15. Simple invasion of thyroid gland by tumor.  $\times 30$ .



Fig. 6. Metastasis of thyroid carcinoma to skull bone.  $\times 235$ 

under histology) but it later assumed in the course of her disease the histologic features of an adenocarcinoma. One patient with a malignant papillary cystadenoma suffered a recurrence 12½ years after her operation. Another with the same type of neoplasm experi-

enced 2 recurrences over a 2 year period. One patient with an adenocarcinoma had a local recurrence after 1½ years. A second with the same type of tumor had a recurrence 2 years after surgical treatment. A third patient with an adenocarcinoma suffered a recurrence 7½ years following her first operation. There was a papillary adenocarcinoma which recurred twice over a 6½ year period. The last patient with a carcinoma simplex experienced 3 recurrences over a 14 year period. The final status of these 7 patients is unknown.

#### ILLUSTRATIVE CASE REPORTS

**CASE 1. Typical case.** A 53 year old woman had a slowly enlarging mass in the right side of her neck for 10 years. There were no other symptoms. Examination disclosed a 2 by 4 centimeter nodule in the right neck, anterior to the sternocleidomastoid muscle just above the level of the thyroid. The thyroid was negative to palpation. At operation several masses were found in the right neck and the right lobe of the thyroid was the site of malignant change. A block dissection was done. In the laboratory a malignant papillary cystadenoma of the thyroid was found microscopically. There were also 7 lymph nodes isolated including the nodule described. Two of these were partially replaced by the same type of neoplasm.

**CASE 2. Local recurrences.** A 34 year old woman noticed mass in left side of her neck for 3 years which fluctuated in size. Two months before admission she experienced a choking spell and was found to have a recurrent laryngeal nerve paralysis. A biopsy

TABLE VI

Type of tumor	No. of recurrences or metastases	Time interval, years	Site of recurrence or metastases
Malignant papillary	—	6½	Neck, on same side as thyroid tumor
Cystadenoma	—	—	Neck, on side opposite to thyroid tumor
Adenocarcinoma	—	—	Neck, same side as thyroid tumor
	—	—	Neck, same side as thyroid tumor
	—	1	Neck, same side as thyroid tumor
	—	—	1st recurrence in neck on side opposite to original tumor, and 2d recurrence in neck in laterally 3d recurrence in skull as metastases
Papillary adenocarcinoma	—	—	Neck, both on side opposite to thyroid tumor
Carcinoma simplex	—	—	1st recurrence in neck, side opposite to original tumor, and recurrence on neck, on same side as original tumor, and 2d recurrence with fixation of trachea

elsewhere from one of the cervical masses revealed thyroid adenocarcinoma. At operation numerous "aberrant" nodules were present on both sides of the neck, extending from the upper neck into the mediastinum. The entire thyroid was diffusely enlarged. Aberrant tissue had invaded the carotid sheath and pretracheal fascia. In two stages a left total hemithyroidectomy and radical dissection of left side of neck was done followed by a right total hemithyroidectomy and partial neck dissection. Microscopically there was a well differentiated adenocarcinoma in the thyroid. Of 5 nodules isolated from the right side 4 were lymph nodes partially replaced by cancer and the fifth was composed entirely of tumor tissue. Of 5 nodules isolated from the left side 3 were negative lymph nodes and 2 contained metastases. Blood vessel, lymphatic, and stromal invasion were marked.

Twenty months later after several series of x ray treatments the patient was reoperated upon because of recurrence about the trachea. Eight months after this procedure she was treated with surgery for a third time because of local recurrence. Microscopic sections of tissue removed at these operations revealed the same tumor as was originally seen. The final status of the patient is unknown.

**CASE 3. Data insufficient for final diagnosis.** A 43 year old woman was admitted to the hospital because of a lump in her neck. Seven years before she had had a left hemithyroidectomy for Graves disease and 5 years before had a partial thyroidectomy also because of thyrotoxicosis. Four years after the second operation a nodule developed in her neck, which proved to be thyroid tissue. Two months before admission a second mass appeared to the right of the thyroid cartilage. There were no other symptoms. At operation numerous nodules were found about the right internal jugular vein which had to be divided. The thyroid region was not examined. Pathological reports on the tissue previously removed were not available. At the present pathological examination 11 nodules were isolated. Of these one was a negative lymph node 4 were nodes partially invaded by thyroid neoplasm and the remaining were thyroid neoplastic tissue not identifiable as lymph nodes. Histologically the tumor was pleomorphic but predominantly a malignant papillary cystadenoma.

**CASE 4. True ectopic thyroid.** A 49 year old woman had a thyroidectomy 30 years ago. 11 years after the operation a lump appeared in right side of neck and slowly enlarged. There were no other symptoms. At operation 19 years after the appearance of the cervical mass a tumor 2 centimeters in diameter was located beneath the skin just at the tip of the old scar. The thyroid remnants on the right side were negative to palpation. Microscopically the excised tissue showed the histology of a fetal adenoma, completely encapsulated and exhibiting no evidence of invasiveness or cytologic malignancy.

**CASE 5. Tumor of thyroid and lateral cervical mass removed elsewhere.** A 7 year old boy was operated

upon at another hospital where an encapsulated mass was excised from the thyroid gland and another mass removed from the left side of the neck. The microscopic diagnosis was adenocarcinoma which was confirmed by Dr. Shields Warren. Two months later he was admitted to this institution for an exploration of his neck and for advice as to future management. At operation the thyroid appeared to be negative. Eight small nodules located along the course of the internal jugular vein bilaterally and thought to be aberrant thyroid tissue were excised. The thyroid was not removed. Microscopically the 8 nodules were lymph nodes.

## DISCUSSION

Numerous pitfalls beset the study of aberrant thyroid tissue. First it is obvious that many of the early case reports were incomplete (1, 9, 23, 24, 26, 29, 33, 35). Excision of lateral masses was accomplished without inspection or palpation of the thyroid before or during operation. Furthermore clinical and operative examinations of the gland were often inadequate. In this series almost 15 per cent of the cancers of the thyroid gland were not palpated before operation and one was missed during the surgical procedure only to be discovered in the laboratory. In more recent years as the thyroid has been examined more closely or removed at operation for lateral aberrant thyroids more and more neoplasms have been found (2, 3, 4, 7, 10, 12, 19, 22, 37). Crile has particularly pointed out that thyroid cancer was occasionally not perceived until the gland was lifted from its bed and its posterior surface studied (8).

A second pitfall exists because of the confusion between lateral thyroid neoplasms as observed in this paper and ectopic fragments of thyroid tissue found occasionally at autopsy or rarely during thyroidectomies. The latter masses are not true tumors and are of two types. One type is an encapsulated fragment of tissue usually measuring between 3 to 5 millimeters in diameter which though completely separated from the gland is directly contiguous with the capsule. Histologically it is composed of a normal thyroid architecture. Other larger masses comprise the second type are found in the mediastinum or supraclavicular regions and are associated with enlarged adenomatous thyroids which have endured longstanding disease. Histologically these show



Fig. 6 Metastasis of thyroid carcinoma to skull bone. X245

under histology) but it later assumed in the course of her disease the histologic features of an adenocarcinoma. One patient with a malignant papillary cystadenoma suffered a recurrence 12½ years after her operation. Another with the same type of neoplasm exper-

enced 2 recurrences over a 2 year period. One patient with an adenocarcinoma had a local recurrence after 12½ years. A second with the same type of tumor had a recurrence 2 years after surgical treatment. A third patient with an adenocarcinoma suffered a recurrence 7½ years following her first operation. There was a papillary adenocarcinoma which recurred twice over a 62½ year period. The last patient with a carcinoma simplex experienced 3 recurrences over a 14 year period. The final status of these 7 patients is unknown.

TABLE VI

Type of tumor	N. of recurrences or metastases	Time interval, yrs.	Site of recurrence or metastases
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Cystadenoma			Neck, on side opposite to thyroid tumor
Adenocarcinoma			Neck, same side as thyroid tumor
			Neck, same side as thyroid tumor
			Neck, same side as thyroid tumor
			1st recurrences in neck on side opposite to original tumor, 2nd and 3rd recurrences in neck, 4th laterally, 5th recurrence in skull as metastases
Papillary adenocarcinoma			Neck, both on side opposite to thyroid tumor
Carcinoma simplex			1st recurrence in neck, side opposite to original tumor, and recurrence neck, on same side as original tumor, 2nd recurrence laryngeal, 3rd in neck.

#### ILLUSTRATIVE CASE REPORTS

**CASE 1. Typical case.** A 23 year old woman had a slowly enlarging mass in the right side of her neck for 6 years. There were no other symptoms. Examination disclosed a 2 by 4 centimeter nodule in the right neck, anterior to the sternocleidomastoid muscle just above the level of the thyroid. The thyroid was negative to palpation. At operation several masses were found in the right neck and the right lobe of the thyroid was the site of malignant change. A block dissection was done. In the laboratory a malignant papillary cystadenoma of the thyroid was found microscopically. There were also 7 lymph nodes isolated, including the nodule described. Two of these were partially replaced by the same type of neoplasm.

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## DISCUSSION

Numerous pitfalls beset the study of 'aberrant' thyroid tissue. First it is obvious that many of the early case reports were incomplete (1, 9, 23, 24, 26, 29, 33, 35). Excision of lateral masses was accomplished without inspection or palpation of the thyroid before or during operation. Furthermore, clinical and operative examinations of the gland were often inadequate. In this series almost 15 per cent of the cancers of the thyroid gland were not palpated before operation and one was missed during the surgical procedure, only to be discovered in the laboratory. In more recent years, as the thyroid has been examined more closely or removed at operation for 'lateral aberrant thyroids' more and more neoplasms have been found (2, 3, 4, 7, 10, 12, 19, 22, 37). Cline has particularly pointed out that thyroid cancer was occasionally not perceived until the gland was lifted from its bed and its posterior surface studied (8).

A second pitfall exists because of the confusion between lateral thyroid neoplasms as observed in this paper and ectopic fragments of thyroid tissue found occasionally at autopsy, or rarely during thyroidectomies. The latter masses are not true tumors and are of two types. One type is an encapsulated fragment of tissue usually measuring between 3 to 5 millimeters in diameter, which, though completely separated from the gland, is directly contiguous with the capsule. Histologically it is composed of a normal thyroid architecture. Other larger masses comprise the second type, are found in the mediastinum or suprasternal regions and are associated with enlarged adenomatous thyroids which have endured longstanding disease. Histologically these show

a colloid adenomatous structure. Pemberton suggests they are pinched off from the thyroid gland by scarring (18). Four such cases were mentioned early in this paper but were not included in the analysis because they did not form true tumors in the lateral aspects of the neck.

A third pitfall is related to the peculiarities of thyroid tissue biologically and cytologically. The patterns of growth in diseased glands are amazingly variable and especially is this true for the low grade thyroid malignancies. Graham demonstrated long ago that portions of thyroid cancers can mimic microscopically the entire gamut of cellular change found in non-neoplastic disease (13-14). He insisted and this series reaffirms it, that the important signs of malignancy are the invasive features. Since morphologic alteration is so slight, pathologists in the past have often not recognized thyroid cancer. Biologically also the low grade thyroid cancers especially those with papillary structures, are slow-growing and tend to cause death late. Numerous documented case reports only now being described in the medical literature attest to this phenomenon (5-8-12-18). The growth and expansion of these tumors should more often be measured in decades rather than years. Moreover metastases may outgrow in size the original tumor and may proliferate for long periods before causing death. Previous to 10 years ago the reported cases were insufficiently followed and the complete history of them had not been traced to the end.

A final pitfall of the subject is concerned with lymphoid tissue. Thyroid glands diseased for long periods of time be they of the hyperplastic or nontoxic adenomatous types tend to accumulate lymphoid tissue and even well formed follicles. In addition embryologists have noted the development of lymphoid aggregates about differentiating cell clusters derived from various branchial pouches. Hence, many authors feel that the presence of lymphoid tissue in and around thyroid tissue does not signify a lymph node. But lymphoid stroma in diseased thyroids do not reduplicate the architecture of a node, for sinuses are lacking. The histologic picture of thyroid neoplasm surrounded partly or wholly by a fibrous

capsule, a row of follicles with germinal centers and sinuses can usually be recognized as a metastasis to a lymph node. Rarely is the combination of capsule follicles and sinuses found in diseased thyroids and then only in Hashimoto's struma.

After anatomists noted ectopic thyroid nodules in the neck (15-16) and after embryologists described the genesis of the gland (17) it was an easy and logical step to postulate a theory of embryonal rests. To this assumption there have been several additions. Schrager hypothesized that the embryonal rests were 'inferior' thyroid tissue and that they enlarged when demands upon the thyroid became excessive. Others felt that embryonal rests were prone to become neoplastic and then metastasize to the thyroid and regional lymph nodes (2-3-12-22). Cohn and Stewart, in order to explain the presence of tumor in the thyroid gland as well as in the lateral neck, theorized that in some cases the lateral primordium retained its identity after fusion with median anlage of the fetal thyroid.

These theories are inadequate to explain the many facets of the problem. First it is agreed among embryologists that cell aggregates from the fourth branchial pouch fuse with the median anlage of the fetal thyroid. Beyond this there is no agreement. Kingsbury maintained that the lateral primordia degenerated after fusion (20-21) while Norris and Weller stated that the fourth pouch contributed functioning thyroid follicles to the gland (27-28-36). Second there is no morphological or physiological evidence for 'inferior' thyroid tissue.

'Lateral aberrant thyroid tissue is neoplastic and does not resemble normal hyperplastic, or adenomatous thyroid tissue. Nor do patients with cervical masses of thyroid tissue exhibit thyrotoxicosis to suggest increased stress upon the thyroid. Third Mahorner and associates have demonstrated that the lymphatics of the thyroid carry away from the organ. Fourth, if it is conceded that the lateral primordia form functioning thyroid tissue, and if Norris and Weller are correct in stating that they form the upper poles of the two lobes, then neoplasms in the gland derived from rests, should arise in the upper poles. In the present series cancer was present in the in-

terior pole alone at least five times and in the isthmus once

If lateral aberrant thyroids are a result of defective embryogenesis, then occasionally at least, thyroid remnants and tumors should be found in branchial cleft cysts which represent anomalous development of one or more branchial pouches. Among 113 branchial cleft cysts operated on in this institution only 3 tumors were found and none of these was composed of thyroid tissue. Crile and Kearns described only epidermoid carcinoma in 28 branchial tumors (6). Nor are remnants of thyroid tissue seen in branchial cleft defects. On the other hand median aberrant thyroid tissue is often associated with thyroglossal duct cysts (30). The thyroglossal duct is derived from the development of the median anlage, which grows out of the pharyngeal pouch. Collections of thyroid acini were present 77 times among 190 patients operated upon here for this fetal anomaly (11). It is noteworthy that "lateral aberrant thyroid tumors have not shown similar clusters of thyroid acini nor have the lateral neoplasms been discovered developing from such thyroid follicles.

As for the distribution of the cervical masses it is too widespread to be contained within the tract of the migrating fourth pouch. The lateral tumors have been found external to the carotid artery subinternally at the mastoid process and in the submaxillary triangle sites which are beyond the anatomic wanderings of the primordial lateral thyroid.

Finally there is a marked similarity between the so-called lateral aberrant thyroid tumors and the malignant papillary cystadenomas of the thyroid gland. They resemble each other in age and sex distribution in length of the pretreatment interval, in their histology biology and final outcome. An analysis of 120 malignant papillary cystadenomas in our laboratory revealed no essential difference from the lateral aberrant tumors with the one exception that the latter were discovered clinically before the presence of a cancer in the thyroid was noted (11). A comparison with Pemberton's data on papillary carcinomas of the thyroid also disclosed the similarity between the lateral cervical tumors and papillary

neoplasms. His and our data show that the histological, biological, and clinical features of the two groups are the same (31, 32).

Our data indicate that lateral thyroid tumors of the neck are metastases from cancers of the thyroid. This is supported by the following: (1) all thyroid glands received in the laboratory contained a tumor which was histologically identical with the neoplasms in the lateral neck; (2) in the majority of cases some of the lateral masses clinically regarded as aberrant thyroid tissue were either lymph nodes partially replaced by tumor or uninvolvement (3) the distribution in the neck of the lateral masses was the same as the anatomical disposition of cervical lymph nodes; (4) the characteristics of these lateral tumors were the same as the low-grade papillary carcinomas of the thyroid; (5) study of branchial cleft cysts and thyroglossal ducts embryologic anomalies associated with thyroid development revealed no evidence that lateral aberrant thyroid tumors develop from embryonal rests.

#### SUMMARY

1. An analysis was made in 57 cases clinically diagnosed lateral aberrant thyroid tumors. Six other cases were not included because they proved not to be tumors on histologic examination.

2. In 49 of the 57 cases there was an associated thyroid cancer. 15 per cent of these were not detected clinically. In the remaining 8 cases the thyroid gland was not received in the laboratory either because they were removed elsewhere or because they were regarded as uninvolved by tumor at operation.

3. The histology of the tumor in the thyroid and in the lateral masses of the neck was identical in all but 1 instance. It was usually papillary in structure though the neoplastic growth patterns were markedly pleomorphic.

4. In 40 of the 57 cases the lateral tumors were found to be metastases to cervical lymph nodes. In the remaining 17 cases there was no microscopic evidence that the lateral tumors were either metastatic or derived from embryonal rests.

5. These neoplasms tend to occur in a younger age group than does cancer in general.

or than does thyroid disease. The presenting finding is usually only a swelling or nodule in the neck, with an average pretreatment interval of almost 4 years.

6 The disease often recurs locally unless completely eradicated by surgery. Follow up observations must be made over decades rather than years.

7 The data indicate that most if not all lateral thyroid tumors of the neck are metastases from cancrs of the thyroid

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# EVALUATION OF SKIN GRAFTING IN THE TECHNIQUE OF RADICAL MASTECTOMY IN RELATION TO LOCAL RECURRENCE OF CARCINOMA

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THE percentage of patients alive and free from recurrence or metastasis 5 years after operation is the common measure of the effectiveness of radical mastectomy in the treatment of carcinoma of the breast. In the course of the years since the Halsted technique of radical mastectomy was established, the percentage of 5 year cures has increased progressively. Although the basic principles of the technique of operation as developed by Halsted are in use in many clinics throughout this country certain variations have been developed. These variations concern the type of incision and the amount of mammary skin which is removed. While subcutaneous tissues and musculature may be excised freely from the thoracic area, the necessity for wound closure restrains the surgeon in the excision of wide margins of skin. The introduction by Halsted of the use of skin grafting made radical excision of skin a more feasible step. Still there is active dispute concerning the amount of skin which should be removed in conjunction with a given tumor. The opinion has been expressed that only by wider excision of skin can local recurrence be made less frequent and the percentage of 5 year cures increased. In an attempt to come to an understanding of the relative value of the wide removal of skin the case records of patients subjected to radical mastectomy at The New York Hospital have been reviewed. In this analysis attention has been given to the relation of the use of a skin graft to the occurrence of local recurrence and to the rate of local recurrence as an indicator of the development of widespread metastases.

The basis of this study is the 255 patients on whom radical mastectomy was performed for carcinoma of the breast from September 1, 1932 to September 1, 1942. The shortest period of follow up is 5 years. Operative surgery in these cases was done by 15 different surgeons most of whom served as resident surgeon at the time. The basic steps of radical mastectomy followed the technique of Halsted (1) preliminary biopsy with microscopic examination to ascertain the nature of the lesion (2) preparation of the skin of the thigh as the donor site for a thick-split graft of the skin (3) use of a circular or elliptical incision about the tumor at a distance of at least 5 centimeters from its palpable margin (4) extension of the incision from its central ellipse superiorly to the middle or lateral third of the clavicle and inferiorly to the costal margin (5) reflection of flaps of skin and a small amount of subcutaneous tissue superiorly to the clavicle medially to the mid sternum inferiorly to a point below the costal margin and laterally to the border of the latissimus dorsi muscle and the humeral insertion of the pectoralis major muscle (6) detachment of the pectoralis major and minor muscles and their fasciae from their origins on the chest wall and their insertions into the humerus and coracoid process (7) complete dissection of the axillary vein to permit removal of all of the contents of the axilla including lymphatic vessels and glands adipose and areolar tissue (8) removal of breast axillary contents pectoralis major and minor muscles en masse (9) reconstruction of a high axilla by obliteration of dead space and suture of the upper and outer cutaneous flap to the chest wall immediately posterior and inferior to the axillary vein (10) suture of the margins of the cutaneous flaps superior to, medial to and inferior to a central defect on the chest wall (suture is effected without undue tension while the arm is held in abduction at an angle of 90 degrees) (11) application of a thick



TABLE I — ANALYSIS OF LOCAL RECURRENCE IN RELATION TO SIZE OF TUMOR, AXILLARY METASTASIS AND THE USE OF A THICK SPLIT GRAFT IN CLOSURE OF THE WOUND

With grafts

Diameter of palpable tumor centimeters	Axillary metastasis No.	Local recurrence No. %	No axillary metastasis No.	Local recurrence No. %	Total No.	Local recurrence No. %
0-	24		3		27	9
1-3	40	6 15			73	16 22
3		6	3		26	4
+	26	6	6		30	16 43
Total	96 (37%)	27	12 (3%)	6	114	26

Without grafts

0-1				22	6
2-3		6		16	4
3-7				5	9
7+					
Total	21 (40%)	6	11 (3%)	27	10

split graft to the residual open wound on the chest wall and (12) application of a suitable dressing to maintain pressure upon the graft and the flap and to immobilize the arm in slight abduction.

Local recurrence of tumor developed in 44 (17 per cent) of the 255 patients. This was in general agreement with the reports of the surgeons who advocate the use of skin grafts in the closure of the wound of the chest wall and yet represented a higher percentage of recurrence than reported by surgeons who tend to avoid the use of skin grafts. Accordingly the cases were divided into two groups on the basis of the use of a graft. This separation of cases showed that contrary to expectation the rate of local recurrence was considerably higher in patients in whom the wounds were closed with a graft than in those in whom closure of wounds was by primary suture of the margins of the flaps. There was local recurrence in 40 (21 per cent) of 188 cases in which a graft was employed. In 67 cases in which the wounds were closed without a graft there were recurrences in only 4 (6 per cent) (Table I). Because of the possibility that grafting had been used more frequently following the extirpation of large tumors and

that this fact might account for the high rate of recurrence, attention was directed to the study of the size of the tumor in relation to the type of closure. Attention was also given to the presence or the absence of axillary metastases.

The patients were divided into four groups on the basis of the diameter of the primary lesion as measured before operation. Also the patients were divided into two groups on the basis of the presence and absence of axillary metastases. Since the surgeon is called upon to complete the radical mastectomy without accurate information as to the histopathology of the tumor and its relative malignancy this study has concentrated on evaluation of the operative steps which are under control at the time of operation.

Review of the cases in which the tumor was small showed that grafts were used in closure of the wounds in 70 per cent of the cases. For the largest tumors as one might expect grafts were used in a higher percentage of cases in this series 87 per cent. For the purpose of ascertaining the relationship of grafting to local recurrence attention is devoted to the smaller tumors. Of the 154 cases in which wounds were closed with a graft local recurrence developed in 24 instances (16 per cent). Of the 62 cases in which wounds were closed without a graft local recurrence developed in only 4 (6 per cent) (Table II). In the group of patients with larger tumors local recurrence occurred in 16 of 34 patients whose wounds were closed with a graft whereas no local recurrences developed in 5 patients whose wounds were closed without a graft (Table II). Thus the evidence on analysis of the small tumors foreshadows that of the large tumors. The use of grafting in the closure of the wound after a radical mastectomy has been performed is associated with a higher incidence of local recurrence.

In the development of local recurrence following radical mastectomy the presence of axillary metastases at the time of operation is a factor of importance. Of the 107 patients with axillary metastases and in whom the wounds were closed with grafts 27 (25 per cent) developed local recurrence. Of the 81 patients without axillary metastases and with

TABLE II.—ANALYSIS OF USE OF THICK SPLIT GRAFTS IN RELATION TO SIZE OF TUMOR

Diameter of palpable tumor centimeters	With grafts No. Per cent	Local recurrence No. Per cent	Without grafts No. Per cent	Local recurrence No. Per cent	Total cases No.
0-3	57 7	1 0	3 30	0	80
3-5	75 73	13 66	8 7	1 4	103
5-7	67	9 4	3	1 0	33
7+	34 87	16 45	8 23		39
Total	85 73	40	67 87	4 6	15

wounds closed with grafts recurrence was noticed in only 13 (16 per cent) (Table I). The number of local recurrences in patients whose wounds were closed without a graft was too small to warrant conclusions. However it is recorded that there were recurrences in 2 of 32 patients with axillary metastasis and recurrences in 2 of 35 patients without axillary metastasis (Table I).

Because of this evidence that axillary metastases predispose to a high percentage of local recurrence it became necessary to cull from the available data the number of cases of axillary metastasis in which the wounds had been closed by skin grafts. Fifty seven per cent of the 188 patients with grafts had axillary metastasis whereas 48 per cent of the 67 patients without grafts had this complication (Table I). This difference is not great enough to parallel the comparative incidence of local recurrence in the two types of cases.

The size of the tumor at the time of operation had an important bearing on the incidence of local recurrence. This can be demonstrated in the patients with and without axillary metastasis. In the very small tumors, the rate of local recurrence was 4 per cent, whereas in the largest tumors, the rate of local recurrence approached 50 per cent (Table I).

The importance of local recurrence as a prognostic sign may be demonstrated by reference to Table III. Of the 255 cases studied, 125 patients (49 per cent) survived more than 5 years and in this group the rate of local recurrence was only 1.6 per cent. One hundred and thirty patients survived less than 5 years and in this group there were 42 local recurrences a rate of 32 per cent. Seven local recurrences developed in 23 patients surviving less than 1 year (30 per cent). 24 in 72 patients surviving 1 to 3 years (33 per cent)

and 11 in 35 patients surviving 3 to 5 years (31 per cent). Thus it may be stated that the development of local recurrence is almost positive assurance that death will occur within 5 years of operation. Thus local recurrence assumes an importance far beyond that of axillary metastasis for 32 per cent of patients with axillary metastasis survived beyond 5 years whereas only 1.6 per cent of patients with local recurrence did so. Although local recurrence is of grave prognostic significance it is not at all clear whether local recurrence predisposes to or is merely a sign of general metastatic spread. Of the 44 local recurrences observed in the 255 cases under consideration 17 appeared before any clinically evident spread had occurred elsewhere, 12 appeared simultaneously with and 15 after general spread. When local recurrence appeared following grafting (40 instances) it was as a nodule or two in the immediate vicinity of the grafted area in 27 cases (67.5 per cent), within the grafted area in 6 cases (15 per cent) and as innumerable foci on the chest wall in 7 cases (17.5 per cent).

#### DISCUSSION

The fact that local recurrence was found commonly in the skin of the chest wall about the grafted area suggests that surgeons had not been radical enough in the sacrifice of skin. The directions given by many surgeons for the performance of radical mastectomy include an

TABLE III.—ANALYSIS OF LENGTH OF SURVIVAL IN RELATION TO LOCAL RECURRENCE

Length of survival	Cases		Local recurrence	
	No.	Per cent	No.	Per cent
5 years or longer	5	40		.6
Less than 5 years	90	6	4	1

admonition to space the elliptical or oval incision of the skin at a specified distance from the palpable margins of the tumor. The dictum that the local lesion should be skirted by at least 5, 7, or even 9 centimeters does not it seems give due importance to the fact that the larger the tumor the more likely has it spread a greater distance from its palpable margin. Thus the suggestion is pertinent that the larger the tumor the more difficult it is to eradicate. Therefore if wide skin excision be practiced for a small tumor much wider excision must be practiced for the large tumor. Practice of this principle may make it possible to reduce the rate of local recurrence and to increase the percentage of 5 year survival. That it probably never will be possible to avoid local recurrence entirely is shown by the fact that approximately 32.5 per cent of local recurrences appear within the grafted area, or as very widespread and innumerable foci. These foci may very well result from retrograde extension from residual intercostal and internal mammary lymphatics. It is on the 70 per cent of local recurrences which appear as discrete nodules near the grafted area or line of closure that the surgeon must concentrate. Obviously it is impossible to set down the specific spot at which the scalpel should be placed for each size of tumor. However since the pectoral fascia, pectoral muscles and axillary contents may be thoroughly excised it would seem the logical next step to carry the proposals of Halsted, J. S. Rodman, Haagensen, Lewis and Rienhoff and Eggers de Choinoky and Jessup one step farther and to excise proportionately more skin the larger the tumor rather than have a more or less fixed limit of cutaneous excision for tumors of variable size.

The only reason for failure to remove a very wide margin of skin is the surgeon's reluctance to have the patient left with a large defect on the chest wall. It is not new to call for wider removal of skin for Lewis and Rienhoff found cause to state in 1932 that surgeons showed a tendency toward less radical excision of skin

breast have been made the basis of a clinical evaluation of the relation of skin grafting to local recurrence and the importance of local recurrence in the course of carcinoma of the breast.

Local recurrence developed in 44 (17 per cent) of the group of 255 patients. In 188 cases in which a graft was employed in closure of the wound there were 40 instances of local recurrence (21 per cent) whereas in 67 cases of closure without a graft there were only 4 instances of local recurrence (6 per cent). Approximately 70 per cent of the closures of wounds following radical mastectomy made use of grafts regardless of whether the tumor was less than 3 centimeters in diameter, 3 to 5 centimeters in diameter or 5 to 7 centimeters in diameter. Following extirpation of tumors larger than 7 centimeters 87 per cent of wounds were closed with a skin graft. Axillary involvement was present with nearly equal frequency in those cases in which the wounds of mastectomy were closed with a graft (48 per cent) and in those closed without a graft (57 per cent).

The size of the tumor at the time of operation had an important bearing on the incidence of local recurrence. In tumors of the smallest size the rate of local recurrence was as low as 4 per cent whereas in the tumors of largest size, the rate of recurrence was found to approach 50 per cent.

Local recurrence had an important bearing on the length of survival following radical mastectomy. In the 125 patients surviving more than 5 years, local recurrence developed in 1.6 per cent, whereas in the 130 patients surviving less than 5 years, the rate of recurrence was 32 per cent.

Of the 40 instances of local recurrence following grafting, 27 (67.5 per cent) appeared as solitary nodules in the immediate vicinity of the graft whereas only 13 (32.5 per cent) appeared within the grafted area or as multiple metastases both surrounding and within the grafted area. This situation gives rise to the thought that more radical excision of skin might give further protection against local recurrence.

Since the rate of local recurrence seems to be very closely related to the size of tumor at

#### SUMMARY

The case records of 255 patients subjected to radical mastectomy for carcinoma of the

the time of operation it seems likely that local recurrence in the form of solitary nodules outside the area of grafting is related to insufficient removal of skin. The suggestion is therefore made that the excision of skin in radical mastectomy be more radical. With the improved methods of skin grafting now available, it seems indefensible that surgeons should not remove a truly wide area of skin at the time that radical mastectomy for carcinoma is carried out. The larger the tumor the greater the need for very wide excision of skin.

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# THE OBSTRUCTED UTERINE CERVIX

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NO pathological entity in the practice of obstetrics and gynecology is capable of more diverse manifestations than obstructive lesions of the uterine cervix. Such affections occur throughout the entire span of woman's life.

Complications of the obstructed cervix are encountered in practice from adolescence to senility. Some obstructions are congenital in origin but the majority are acquired during postnatal life. Trauma, infection, neoplasms, radiation therapy, and senile atrophy are the leading etiologic factors. Despite their frequency and the gravity of many of their sequelae, obstructions of the cervix, except for the excellent contributions of Curtis, have received but scant attention in the literature. It may be timely, therefore, to review the general problem. Congenital malformations, pathological complications, prevention and treatment are surveyed.

## EMBRYOLOGICAL CONSIDERATIONS

Clinical experience would indicate that perhaps less than 10 per cent of obstructed cervixes are congenital in origin. Developmental stenosis of the cervix may result from incomplete canalization of the distal extremities of the fused müllerian ducts. The obstruction in such cases may be situated at the external os (‘pin-point os’) anywhere along the cervical canal or at the level of the internal os. Curtis (8) has described the longitudinal ridges which traverse the length of the anterior and posterior cervical walls. From these elevations extend obliquely directed rugae, the *plicae palmatae*. The thickness of these ridges varies in different subjects and it is known that hyperplasia sometimes occurs to such an extent that actual obstruction, particularly at the time of premenstrual congestion, takes place. Curtis cautions that without anesthesia at times it may be almost impossible to dis-

tinguish the resistance of the normal oblique folds from the resistance offered by the pathologically obstructed cervix. The obliquely directed rugae have the tendency to ‘catch’ the uterine sound. Certain cervixes may be stenotic at the external os only, the canal proper and internal os being patent. Stenoses at the internal os may be either apparent or real. In small anteфлекed uteri it is often difficult to pass the standard uterine sound, whereas the No. 1 or No. 2 Hegar sound may be introduced with ease, especially if gentle traction is exerted by means of a tenaculum on the cervix which tends to rectify the abnormal flexion in such uteri. In the study of a suspected stenosis, another useful technique is to bend the tip of the uterine sound at a much shorter and sharper angle, when it may be that the internal os may be passed without difficulty, whereas otherwise the tip of the sound may possibly impinge upon the posterior wall of the cervix.

In evaluation it may be said that although congenital strictures of the cervix may occasionally occur, their significance and precise pathogenesis remain a provocative subject for embryological, anatomical and clinical investigation. Examination under anesthesia is sometimes necessary to establish the presence of a genuine obstruction of developmental origin. The notion that most instances of primary dysmenorrhea are based upon a congenital stenosis of the cervix is no longer tenable, although a small percentage of dysmenorrheic patients presenting a rigid, narrow cervix, particularly at the internal os, are benefited by dilatation of the cervix with or without the use of an intrauterine stem pessary (12, 27, 39).

## ACQUIRED LESIONS

It is instructive to consider the wide variety of processes which have been found capable of producing an acquired stenosis or atresia of the cervix. A tabulation of the primary causes is presented in Table I.

**1 Infection** According to Ashton ulcerative changes in the vagina associated with diphtheria, scarlet fever and smallpox may close the external os. It is conceivable that intrauterine or neonatal infections of the lower genital tract may have the same effect. Gonococcal endocervicitis is a well known cause of cervical stricture. The lacerated and bruised puerperal cervix is fertile soil for bacterial invasion. fibrinous synchia are readily converted into fibrous adhesions with subsequent stenosis. In certain instances of tuberculous endometritis enough specific granulation tissue may be elaborated in the region of the internal os so that uterine drainage is obstructed and pyometra results. Cervical strictures are frequently associated with instances of chronic endocervicitis of undetermined etiology. The deposition of fibrous tissue in the cervix is always a probability in any cervix which has been the seat of an acute or chronic recurrent infectious process regardless of the identity of the original infectious agent. Secondary bacterial invaders which are resident months or years after the original infection has been dealt with may have the ability to evoke more intense plastic reactive inflammation than has the primary infectious agent whether gonococcal streptococcal or otherwise. In his chapter on soft tissue dystocia, Schumann cites syphilis among the processes being capable of producing a dense undulatable stricture of the uterine cervix.

**2 Trauma** Practically any instrumentation of the cervix may so traumatize the epithelium that cicatrization with resulting stenosis ensues. Sounding of the uterine cavity which used to be a common office procedure may lead to abrasion of the mucosa, scar tissue and eventual stenosis. Dilatation and curettage if done too thoroughly can be traumatic, too vigorous curettage of the uterine cavity can lead to more or less complete ablation of functioning endometrium with subsequent permanent amenorrhea as well as to removal of too much endocervical mucosa. Cauterization of the cervix especially carbonization of the canal for endocervicitis stands at the top of the etiologic list as the most frequent cause of cervical stenosis of traumatic origin. Kleegman warns of the hazard of cer-

TABLE I—ETIOLOGY OF THE OBSTRUCTED UTERINE CERVIX

A. Congenital	Hyperplasia longitudinal cervical ridges
	Incomplete canalization caudal ends muellerian ducts
B. Acquired	Infection
	Vaginitis
	Cervicitis
	Syphilis
	Trauma
	Pelvic delivery
	Abortion
	Instrumentation
	Cauterization
	Conization
	Amputation
	Trachelorrhaphy
	Duchenne's incisions
	Hysterotomy vaginal
	Hysterectomy supracervical
	Caustic medicaments
	Foreign bodies
	Radium and x ray
	Neoplasms
	Carcinoma cervix
	Carcinoma corpus
	Myomas
	Adrenal tumors
	Uterine calculus
	Senile contracture

vical strictures and stenoses that attends electrosurgical methods of treating cervicitis. In the year 1906 Hunner recommended the Paquin cautery in the treatment of chronic endocervicitis. In the year 1911 Dickinson used the fine wire nasal tip instrument for the treatment of cervicitis.

Shaw reports a fatal case of peritonitis resulting from cauterization of the cervix at the time of supracervical hysterectomy. Autopsy traced the peritonitis to a postcauterization stump abscess. His comment is that the patient might have been saved by more thorough dilatation of the cervical canal after cautery.

Amputation of the cervix, trachelorrhaphy and tracheloplasty have all been followed by stricture or stenosis of the remaining cervix. Block reports an incidence of cervical stricture in 9 per cent of the patients subjected to conization of the cervix. Hendriksen in his report on 6550 cervical stumps calls attention to the occurrence of stricture in the 'frozen' stump with occasional abscess formation in the cervical wall and cervical pyometra. The topical application of necrotizing chemicals such as strong silver nitrate, chromic acid and other corrosive substances to

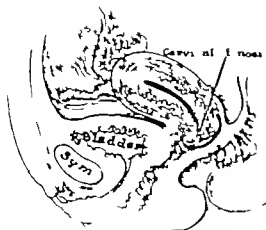


Fig. 1. The external os is the commonest site for stricture or stenosis. This is the usual location for stenosis subsequent to cauterization of the cervix.

the cervical canal can evoke such tissue destruction that cicatrization and stenosis result. Frank relates how a forgotten piece of cervical gauze retained *in situ* for 2 years resulted in traumatic stenosis and hematometra. The perennial wearing of stem pessaries whether for therapeutic or contraceptive purposes may be followed by the same train of events. Israel and Harrel report 3 cases of severe pelvic inflammation which resulted from the employment of intracervical wish-bone pessaries used to achieve prolonged contraception. The indications and contraindications for stem pessaries have been thoroughly taken up by Weir, Douglass and Melody.

Vaginal delivery spontaneous or operative, abortion spontaneous or induced, vaginal hysterectomy, Dührssen's incisions of the cervix and the repair of fresh puerperal lacerations of the cervix, all have been followed by stenosis and stricture in certain instances. Bernstein and Walter found that injury sustained during delivery followed by infection was the most common cause of cervical stenosis in a group of 8 patients who developed hematometra; such etiology accounted for 3 of their cases. Inept forceps rotations, with shearing of the endocervical mucosa, lay bare the field for the deposition of dense scar tissue and eventual stricture. Previous anterior vaginal hysterotomy has been seen to result in such a stenotic cervix that the next pregnancy required termination by cesarean section (30).

**3. Radiation therapy.** The fibroplasia and cicatrization subsequent to radiation therapy, whether radium or x ray, is a well known cause of cervical stricture and stenosis. Arneson warns how the fibroplasia following x ray therapy for cervical carcinoma may make virtually impossible the insertion of intrauterine radium at a later date. In the year 1929 Bland made an interesting report upon the occurrence of pyometra following radium therapy for uterine cancer. He regarded pyometra as analogous to pyonephrosis in the kidney, where the dominant character is not the supuration but the retention with distention of the organ. Carter analyzed 39 cases of pyometra from a bacteriological critique. He found that sterile pyometra occurred most frequently in uteri with carcinoma both before and after treatment, whereas no case of pyometra which occurred spontaneously that is without previous operation or radiation therapy was sterile. An interesting case of post-radiation cicatrix of the cervix with stenosis of the cervical canal and hematometra, occurring in a 35 year old secundipara who had previously received intrauterine radium for dysfunctional bleeding and subsequently estrogens to allay vasomotor symptoms of the menopause, has recently been reported (26). Estrogens activated the endometrium with resulting menstruation which was retained and gradually distended the uterus, drainage from which was obstructed because of postradiation cicatrix of the cervix. When the uterus was opened following hysterectomy the cervical canal was found to be completely obliterated and the uterine cavity was full of blood, some fresh and some obviously old.

**4. Neoplasms.** Carcinoma of the uterine cervix, especially the endophytic variety, is a frequent cause of cervical obstruction with resulting pyometra. Corporal carcinoma, if situated near the isthmus, may cause blockage of uterine drainage, with attendant pyometra. A cervical myoma which grows into the canal can so obstruct menstrual drainage that acquired dysmenorrhea and hematometra may result. A relatively small myoma situated in the lower uterine segment or cervix may so effectively block the birth canal that abdominal delivery is necessary. An impacted mter

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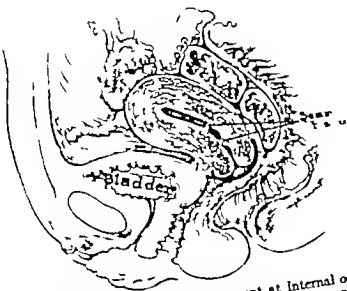


Fig 2 Dense scar tissue is present at internal os and in the cervical canal. Such encrustation has been encountered months or years after the use of intrauterine radium therapy



Fig 3 Submucous myoma bulging into the uterine cavity the caudal half of which is almost obliterated. Obstructed uterine drainage results from the ball valve action of such a myoma

Initial myoma of the posterior cervical wall may be an absolute obstruction to vaginal delivery. A pedunculated submucous myoma by protruding through the cervical canal in a ball valve fashion, may give rise to severe reflex uterine contractions and effectively obstruct uterine drainage, until it has been delivered through the cervix. Carter quotes a report by Reeb in 1928, in which the latter recounts the case of a 77 year old woman with a calcified concretion, so called 'womb-stone,' blocking the cervix with the production of pyometra, the patient had undergone dilation and curettage and radium application at the age of 44 for a small myoma. According to Scanzoni (32) obstructed uterine drainage may result from the extrinsic pressure of an ovarian cyst or neoplasm.

5 *Senile contracture* Senile atresia or contracture of the cervix is a natural part of the process of postmenopausal involution of the genitalia. The cervix becomes smaller and more conical in appearance. If secretions from the endometrium accumulate and are trapped behind the cervix bacteria invading by way of the cervix produce endometritis and eventual pyometra. This train of events may occur spontaneously in a cervix which has not been the seat of previous operation or malignancy. The syndrome of intermittent cervical obstruction in postmenopausal wom-

en in which secretions accumulate giving rise to backache and lower abdominal distress only to be promptly relieved by the rather sudden escape of watery blood tinged leucorrhea has been described by Faulkner. The indiscriminate use of estrogens in postmenopausal women who have a closed cervix often eventuates in activation of the endometrium with resulting bleeding and trapping of the blood in the uterine cavity (hematometra). What with the ever growing number of postmenopausal women and particularly those who have had previous trauma infection or surgery upon the cervix the production of hematometra from the injudicious use of estrogens is becoming more and more common.

## SYMPTOMATOLOGY

A galaxy of syndromes may result from an obstructed uterine cervix depending upon several variables namely (1) the location of the obstruction (2) the degree of the obstruction that is whether complete (atresia) or incomplete (stenosis) (3) the manner in which the obstruction occurs that is whether congenital or acquired, (4) the period of the woman's life when the obstruction manifests itself that is the menarche the childbearing, or the postmenopausal era and (5) the nature of the trapped secretions that is inflammatory products or blood.





Fig. 4. Pedunculated fibroid polyp approaching internal os. Gradual growth of polyp results in its extrusion through the cervical canal.

**1 Cryptomenorrhea** Obstructed uterine drainage may be manifested by delayed menarche. The patient often presents herself with a chief complaint of primary amenorrhea. Careful anamnesis however may reveal that the individual has had cyclic moulins, with out, however any external bleeding. The commonest site of obstruction in such instances is the external os. The retention of menstrual blood over a period of months or years may gradually distend the uterus so that it becomes a soft symmetrically enlarged viscus the size of a gravid uterus of 3 or 4 months. The cervix may become converted into a smooth soft mass at the apex of the vagina, the cervical canal having become ballooned out by the hematometra process. The external os may be hardly visible and then only as a pigmented puckered point in the apex of the vaginal vault.

**2 Dysmenorrhea** Curtis (9) states that the pain of obstructed uterine drainage varies from ill-defined discomfort to severe cramps. It used to be widely held that the hypoplastic acutely anteverted uterus, so often associated with primary dysmenorrhea, presented an actual obstruction at the internal os. However many patients with such uteri complain of cramps hours or even days before there is the slightest suspicion of flow hence the pathogenesis of pain in such cases is apparently based on some mechanism other than stenosis

of the cervix. Very probably it is associated with hyperemic distention of the viscera. Wear (40) has found that bending the tip of the uterine sound at a much shorter and sharper angle will often permit it to pass the internal os when otherwise the sound would obstruct against the posterior cervical wall at the level of the internal os. Traction on the cervix by straightening the acute angle at the internal os, often helps in achieving passage. Nevertheless in a rather small percentage of patients with a diminutive anteverted uterus it will be found that the internal os is so narrow and rigid that even the small surgical sound can only be passed with the greatest difficulty. In such instances clots may form in the uterine cavity and require forceful cramps to expel them. Such a narrow rigid internal os is almost certainly of congenital origin and the dysmenorrhea might properly be called obstructive.

An interstitial myoma in the cervix may gradually block the canal and give rise to severe acquired dysmenorrhea, from the reflex uterine contractions evoked in overcoming the obstruction. A pedunculated submucous myoma may give rise to continual uterine colic, until the tumor has been delivered through the external os.

**3 Menorrhagia.** Prolongation of the menses is frequently the presenting symptom in women of the childbearing age who have cervical obstructions. The period may last from 5 to 10 days and the bloody discharge may be intermittent during the bleeding episode. Not infrequently the actual bleeding phase passes over into an interval during which there is a more or less persistent discharge of tarry material which may last practically until the onset of the next menses.

**4 Leucorrhea.** This is perhaps the commonest complaint caused by cervical stenosis in women in the reproductive and postmenopausal eras. Assuming that the usual infective incitants have been excluded, persistent or recurrent leucorrhea in women of the childbearing age will often be found to be associated with an obstructed cervix. As pointed out by Henriksen leucorrhea, odorless or malodorous, is a not uncommon complication of supracervical hysterectomy and results from the de-

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development of stricture in the remaining cervix. The obstruction is usually found at the external os and, according to Henriksen, investigation will often disclose abscesses in the cervical wall or frank cervical pyometra. The tendency of the cervical stump to develop strictures has been attributed to impaired blood supply following ablation of the corpus uteri and to the cessation of the cyclic menstrual discharge through the cervical canal. The sudden onset of profuse leucorrhea in a postmenopausal woman requires that gynecologic investigation exclude the presence of cervical stricture. Gradual closure of the cervix is a natural concomitant of the genital atrophy seen in senile involution. Faulkner describes the syndrome of intermittent cervical obstruction in postmenopausal women, characterized by low backache, vague lower abdominal pain and the sudden issue of a watery pinkish vaginal discharge. Dilatation and curettage done to exclude uterine malignancy reveals a stenotic cervix. The patient may remain asymptomatic for months or years, until secretions trapped behind the blocked cervix develop sufficient pressure-head to break through the obstruction thus repeating the syndrome of intermittent cervical obstruction. The alternate retention and drainage of trapped uterine secretions after menopause has been known to go on for years. If bacteria invade the uterine cavity through the stenotic cervix, endometritis followed by pyometra ensues.

**5 Senile vaginitis** If there is little or no response to the usual medical treatment for atrophic vaginitis, the possibility of cervical stricture should be investigated. Cicatricial changes in the postmenopausal cervix sufficient to block the lumen of the cervix are frequent. Bacterial invasion of the trapped secretions may produce copious inflammatory products which gradually build up pressure head and seep through the cervix. The thin senile vaginal mucosa with its low glycogen content is readily irritated by such exudates. Without first establishing adequate surgical drainage of the retained inflammatory products, acidic vaginal douches and estrogens which in the uncomplicated case of senile vaginitis are usually so salutary, are quite ineffectual.

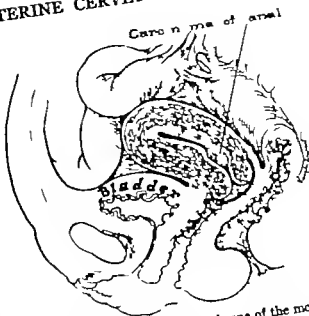


Fig. 5 Carcinoma of the cervix is one of the most common causes of pyometra.

**6 Postmenopausal bleeding** In his analysis of 179 cases of postmenopausal bleeding TeLinde found 6 cases (3.4%) to be due to chronic endometritis. In 5 of the 6 cases pyometra was found at operation. In the sixth case no mention was made of it in the operative note. The cause of the pyometra in the 5 cases was a benign stenosis of the cervical canal associated with senile contracture of the cervix. The typical presenting complaint in these patients was a blood tinged purulent discharge. Microscopic examination of the endometrium showed typical senile changes with the usual evidence of chronic inflammation. Pratt includes stenosis of the cervix among the many conditions which must be included in the differential diagnosis of bleeding associated with the menopause.

**7 Infertility** Hamblen encountered cervical factors in 32 per cent of childless wives. Endocervicitis occurred in 22 per cent, poor drainage in 6 per cent, and failure to receive spermatozoa in 4 per cent. Pin point external os, or strictures of the canal, impede physiological drainage and lead to inspissation of the mucus plug, with resulting physical and chemical alterations in the cervical mucus which eventuate in impenetrability or chemical hostility to spermatozoa. Impaired drainage often leads to infection and *vice versa*. The finding of thick, opalescent pus in the external os during the mid-cycle, when the cervical secretion should normally be thin transparent



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**11 Endometriosis** The pathogenesis of endometriosis has not been established however it seems not unlikely that an occasional case at least may result from reflux menstruation according to Sampson's theory. In patients suspected of having pelvic endometriosis finding the uterus in normal upright position should invite investigation of the cervical canal as to patency. Curtis (8) has found that a not uncommon cause of obstructed drainage is hyperplasia of the longitudinal ridges of the cervix.

Fullerton (17) feels that reflux menstrual discharge is the etiological factor in perhaps the majority of cases of endometriosis. He believes that a tight cervix can be the cause of reflux perturbed menstruation. Maintaining that at the time of dilatation of the cervix with the usual solid metal dilators the intrauterine pressure is increased by the piston like action of the dilators. Fullerton has suggested that the ordinary dilators be modified by boring a tubular lumen (1 mm. in diameter) longitudinally through the center thus eliminating the piston action within the uterine cavity which he calls an anatomic syringe barrel.

**12 Conglutination of the external os** In this rather unusual obstetrical complication the presenting part is well engaged in the pelvis the cervix thin and effaced and tightly stretched over the presenting part but the os fails to dilate beyond a pin point opening the margins of which are rigid and sharp. This condition is more common in primiparas than in multiparas but has been known to recur in succeeding pregnancies (36). The stenotic external os usually very promptly opens in response to digital insinuation rarely. Dehrmann's multiple incisions are required.

**13 Cervical dystocia** It is recognized that cervical dystocia may result from a galaxy of obstetrical conditions including neurogenic inhibition uterine inertia and cephalopelvic disproportion however previous surgical or other trauma to the cervix may evoke such cicatrization that the cervix will fail to efface and dilate during labor. Failure to recognize such a complication may result in rupture of the uterus (4). The correct treatment is cesarean section after a reasonable and closely

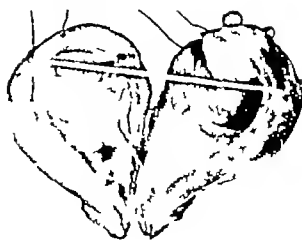


Fig. 6 Specimen removed from a 36 year old null gravida. Complications included primary dysmenorrhea, sterility and menometrorrhagia. The small uterine probe could not be passed through the cervical canal. The cavity was greatly distended from hematometra and the uterine wall was one third normal in thickness. The rather large submucous myoma situated in the fundus uteri was an incidental finding. Note the dense scar tissue in the cervix and the lower uterine segment. The age of the extensive cicatrization could not be ascertained. (Specimen courtesy of Dr. John A. Driscoll.)

supervised trial of labor. Certain instances of rupture of the uterus of rather obscure etiology may be traced to the sudden giving way of a badly scarred cervix with extension of the rupture into the broad ligament (18).

**14 Postpartum pyometra** Revcraft (31) has pointed out the importance of stenosis of the cervix with retention of lochia and pyometra as a cause of puerperal morbidity. The usual history is an operative vaginal delivery followed a week or two later by chills and fever, a tender distended uterus and scant or absent lochia. The same clinical picture may be seen following cesarean section especially when the section has been done for cervical dystocia after a test of labor. Recovery is usually quite prompt after the establishment of adequate surgical drainage by T-tube catheter introduced after gentle dilatation of the closed cervix.

#### TRIUMPHANT

**Historical notes** Sir James Young Simpson (1811-1870) (33) quotes the Hippocratic writings (13th section) wherein the writer recommends that if the cervical orifice be very much contracted it be opened by means of bougies

and watery is evidence of a pathological endocervix. In instances of cervical hostility microscopic study of semen aspirated from the cervical canal will show absence of motile sperm.

The first clue to an obstructed cervix may be the inability to pass the Jarcho cannula at the time of the proposed Rubin's test for tubal patency. The frequency of pregnancies following nothing more than tubal patency test, whether by gas or iodized oil, may well be due as much to the benefit of dilating the cervix in passing the cannula as to the actual perfusion of the testing medium through the uterotubal system.

**8 Hematometra.** This requires a complete obstruction of the lower genital tract and a functioning endometrium. Bernstein and Walter, in reporting 19 instances of hematometra, encountered 8 cases that resulted from cervical stenosis, the other 11 instances were congenital in origin, including imperforate hymen (10 cases) and bicornuate uterus (1 case). Trauma sustained during delivery followed by infection (3 cases) was found to be the most common cause of stenosis. The other etiologic factors were cauterization, surgical removal of a cervical myoma, dilatation and curettage, x-ray and radium therapy, senile cervical contracture, and obstruction resulting from uterine myomas. Amenorrhea, lower abdominal pain, and a symmetrically enlarged soft uterine tumor are the typical findings in hematometra as well as in pyometra. The formation of hematometra is much more spectacular and rapid in development in menstruating than in postmenopausal women. In menstruating women with cervical atresia the distended uterus may enlarge to the size of a 3 months gestation in the matter of several months. Complaints referable to the abdomen may extend from a vague sensation of uneasiness to severe colic like lower abdominal pain. Hematometra as a sequela to the obstructed cervix is being encountered more frequently nowadays as a result of the universal use of cervical cauterization, the frequent utilization of conization of the cervix, and the not infrequent employment of radiation therapy. The case records of the Massachusetts General Hospital have recently included 3

most interesting instances of hematometra, resulting from the administration of estrogens to relieve menopausal symptoms in women with obstructed cervixes. The first patient (23) was a 54 year old woman who developed cervical stenosis as a result of conization of the cervix 4 months previously. The second instance (26) was a 35 year old secundipara whose cervical obstruction resulted from the administration of radiation therapy (radium) 8 months previously for the control of dysfunctional uterine bleeding. A common complication of estrogenic therapy is the so called withdrawal bleeding, a frequent sequela of operative procedures to the cervix is stenosis or atresia, resulting from cicatrization.

**9 Hematosalpinx.** Retained blood may proceed reflux to distend the fallopian tubes (hematosalpinx). If the fimbriated end of the tube is closed pyohematosalpinx may develop. The clinical picture of pyohematosalpinx is indistinguishable from acute salpingitis. If the fallopian tubes are open blood forced into the tubes from the uterus may escape into the peritoneal cavity and there produce varying amounts of hemoperitoneum. Although tubal pregnancy is the most common cause of hematosalpinx, it is well to remember that the latter may be a complication of gynatrauma. The fimbriated end of the tube may close as a result of infection, as in salpingitis, or of aseptic inflammation, as in tubal pregnancy.

**10 Pyometra.** The distention of the uterine cavity with inflammatory products gives rise to much the same symptomatology as is encountered in hematometra. In addition to the lower abdominal discomfort, there may be chills and fever and other evidence of sepsis. The serosanguineous material associated with the pus is thought to be the result of bleeding from the granulation tissue lining the pyogenic membrane into which the uterine cavity is converted. Occasionally the pyometra may result in such a rapid enlargement of the uterus in a postmenopausal woman that cellular myoma or sarcoma may be misdiagnosed and lead to needless hysterectomy (14). An unsuspected pyometra may be revealed in the routine investigation of abnormal uterine bleeding resulting from carcinoma of the cervix, an extremely common cause of pyometra.

As recommended by Weir and Melody a vaginal pessary of the Smith or the Hodge type should be worn concomitantly with the stem to prevent expulsion of the latter. Potter recommends a winged stem pessary to correct stenosis of the external os in certain selected cases of involuntary sterility. He reports having used such a device in 12 patients, in 8 of whom pregnancy subsequently occurred. In Potter's series sterility investigation was entirely negative except for stenotic cervix with associated cervical hostility as demonstrated by the Huhner postcoital test.

**3 Dilatation and evacuation** This is the procedure of choice in instances of pyometra and hematometra. Adequate surgical drainage of the trapped uterine contents may be insured by inserting a rubber T tube catheter such as is used in draining the common bile duct; the catheter should remain until drainage has been complete, which may be a matter of several days to several weeks. This is the ideal procedure for puerperal pyometra. Bacteriological cultures should be taken and processed anaerobically and aerobically.

**4 Anterior lip bisection** Very rarely if the obstruction cannot be opened by divulsion (Atlee and Goodell dilators) or by dilatation (surgical probes and small Hegar dilators) it may become necessary to advance the bladder and to make a small incision in order to find the strictured canal. This approach has been advocated by Curtis (10). Patency may be maintained by means of an intrauterine stem pessary or small rubber T tube catheter the choice depending upon the presence or absence of infection and trapped secretions.

**5 Vaginal myomectomy** Certain obstructing cervical myomas can best be enucleated by the vaginal approach after advancing the bladder. Pedunculated submucous myomas are best removed by snare or by ligation and division of the pedicle if the latter be accessible; otherwise morcellation may be the procedure of choice. Caution must be taken in dividing the pedicle lest the fundus uteri may be cut across inasmuch as the fundus in such cases is sometimes inverted by the traction exerted by the pedunculated tumor. Transperitoneal removal of a pedunculated submucous myoma at the time of abdominal

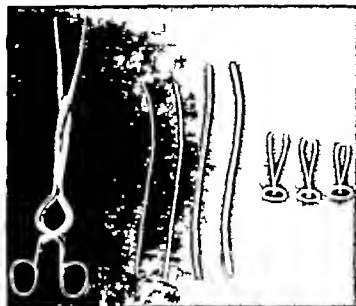


Fig. 9 Instruments for opening strictured cervix. On the left is the Atlee cervical dilator. In the center are Hegar dilators, sizes 1, 2, 3, 4, 5, 6 French. These smaller sizes are usually not included in the routine setup for dilatation and curettage. On the right are intrauterine silver stem pessaries which may be used in selected cases for maintaining patency.

hysterectomy is mentioned to be condemned because of the grave risk of peritonitis from contaminating the peritoneal cavity.

**6 Hysterectomy** Vaginal or abdominal hysterectomy may be the procedure of choice in certain instances of symptomatic stricture of the cervix particularly in women over the age of forty. This may be especially indicated if there are such complaints as increasingly severe dysmenorrhea and persistent vaginal discharge and if the uterus is enlarged and tender to palpation. Greenhill prefers vaginal hysterectomy in such cases.

**7 Radiation** When uterine cancer is associated with pyometra from impaired uterine drainage intrauterine radium is to be avoided until all evidence of infection has disappeared if metritis, pelvic cellulitis and peritonitis are to be averted. Preliminary x-ray in order after surgical drainage has been established the sterilizing effect of roentgen rays in such situations is most striking.

**8 Cesarean section** The rationale of timely abdominal delivery in genuine cervical dystocia is obvious if obstructed labor and its complications are to be avoided. It is pending upon the character of the tumor whether penicillin or streptomycin



Fig. 7. Photomicrograph showing chronic endometritis, associated with pyometra in postmenopausal woman. The benign contracture of the cervix. Uterus globular shaped, rapidly grew to size 14 months pregnancy. Hysterectomy was done because of suspicion of malignant myoma. There is extensive, diffuse infiltration of the endometrium by lymphocytes and plasma cells. Note 1. a large foreign body giant cell frequently encountered in any pyogenic menbrane (Specimen courtesy Dr. Robert L. Faulner)



Fig. 8. Photomicrograph of transsection through normal uterine at 1 time of menstruation. Note islands of menstruating endometrium free in tubal lumen. Rether menstruation may be of biologic importance in some instance of endometriosis. Cervical obstruction, atretic retrodisplacement, and increasing intra-uterine pressure by the use of solid cervical dilators may be factors in promoting retrograde menstruation. (Specimen, courtesy of Dr. Robert L. Faulner)

and leaden instruments. Simpson also refers to a textbook entitled *Afarro of Chirurgery* by one Mr Cook a practitioner of Warwick, in which the author in speaking of closure of the inner orifice of the womb or os uteri recommends it to be enlarged when necessary by gentian root or prepared sponge and after wards by the introduction of hollow instruments of silver ivory or horn and these means, he adds are better than incision. Simpson himself advocates surgical division of the cervix along its entire length with an instrument he called the hysterotome or metrotome. Scanzoni (32) describes his method of evacuating retained menstrual blood in cases of hematometra by means of introducing a trochar into the most depending and accessible point of the tumor which the lower portion of the womb forms in the vagina. He reports having treated 3 such cases of congenital obstruction at the external os with associated hematometra by the aforementioned approach without a fatality and without complications.

1. *Dilatation of the cervix* Opening of the obstructed cervix by means of dilating instruments is the most commonly done surgical procedure in the management of stricture.

When difficulty is encountered in introducing graduated dilators, such as those of the Hegar type much can often be accomplished by employing a spreading or divulsing instrument, such as the Atlee dilator. The latter will often be successful in reopening the natural passageway when a tubular dilator will make no advance whatsoever. If graduated dilators are used it is essential to have available the smallest ones, including the Hegar No. 1 and No. 2 which are usually not included in the ordinary set up for dilatation and curettage. Web-like curtains at the external os can often be opened with the smaller surgical probes if only the puckered point indicating the obliterated external os can be identified. Caution and gentleness should be the watchword in approaching these cases particularly if there be an associated pyometra or hematometra.

2. *Dilatation of the cervix and stem pessary* In the occasional stricture without any associated infection including cervicitis and adenitis the intrauterine silver stem of the Chambers type may be used to advantage after the obstruction has been overcome. The stem may be left in place for 3 to 6 months, to insure maintenance of established patency.

As recommended by Weir and Melody a vaginal pessary of the Smith or the Hodge type should be worn concomitantly with the stem to prevent expulsion of the latter. Potter recommends a winged stem pessary to correct stenosis of the external os in certain selected cases of involuntary sterility. He reports having used such a device in 12 patients in 8 of whom pregnancy subsequently occurred. In Potter's series sterility investigation was entirely negative except for stenotic cervix with associated cervical hostility as demonstrated by the Huhner postcoital test.

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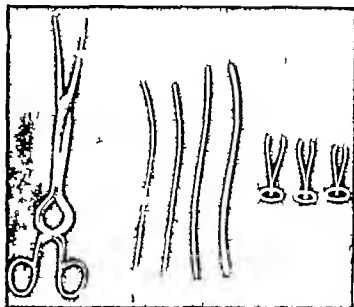


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8 *Cesarean section* The rationale of timely abdominal delivery in genuine cervical dystocia is obvious if obstructed labor and possible uterine rupture are to be avoided.

9 *Antibiotics* Depending upon the bacteriological findings either penicillin or strepto



mycin may be indicated in the prophylaxis of complications after evacuating a hematometra or pyometra. Antibiotics are to be regarded as an adjunct not a substitute for surgical drainage.

#### PREVENTION

The guiding principle with regard to the therapeutics of the cervix uteri should be *primum non nocere*. Accouchement forcé and delivery through the incompletely dilated cervix have no place in modern obstetric practice. It is noteworthy that in a recent analysis of 77 cases of failed forceps in patients admitted to three Dublin hospitals for treatment the cervix was not fully dilated in half of the patients (15). Great care and due gentleness must be observed whenever forceps rotations are required lest damage to the cervix with subsequent cicatrization be sustained. Fresh cervical lacerations and Dehriesen's incisions must be repaired meticulously. Patients who have been subjected to such operative procedures should not be discharged 6 weeks post partum; instead they should be rechecked 3 or 6 months later for possible cervical stricture or atresia.

The widespread use of cauterization, conization, cervical repair and amputation, intra-uterine radium and pelvic irradiation have taken their toll in cicatrized cervixes. It is recognized that the persistent administration of estrogens for the menopausal syndrome not infrequently activates a dormant endometrium into bleeding. If the cervix is closed, hematometra may follow; this train of events is becoming more and more frequently observed. In passing it might be stated that the use of estrogens in not a few instances has been indeed casual. Patients who have been subjected to operative procedures on the cervix including supracervical hysterectomy or radiation therapy should be followed at regular intervals on which visits the cervix should be inspected, palpated and sounded (with all due aseptic precautions) to ascertain and maintain patency of the canal. The Allee cervical dilator is ideal for this purpose, although the smaller Hegar instruments may be quite satisfactory. If a high-grade stenosis is encountered, dilatation may have to be carried out under anesthesia. Cauterization and con-

ization demand periodic follow up observations for at least 6 months.

#### SUMMARY

The general subject of the obstructed uterine cervix has been reviewed. The natural history of cervical obstructions, as well as the clinical syndromes associated therewith, has been considered. A plea has been made for the avoidance of trauma to the cervix both in obstetric and gynecologic practice. A critique of the various methods available in the management of the obstructed cervix has been presented. It has been emphasized that obstructive lesions of the uterine cervix are far from a rarity in everyday practice and will be encountered with increasing frequency as the clinician becomes mindful of their possibility in his evaluation of obstetrical and gynecological problems.

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# THE TECHNIQUE OF SURGICAL DIVISION OF PATENT DUCTUS ARTERIOSUS

OWEN H. WANGENSTEEN M.D. F.A.C.S. RICHARD L. VARCO M.D., and  
IVAN D. BARONOFKY M.D., Minneapolis, Minnesota

WHEN Robert Gross (6) successfully interrupted the continuity of the ductus arteriosus he released an attack renewed in many surgical clinics upon crippling congenital vascular lesions which has brought laurels to surgery and help to patients whose condition heretofore was believed unremediable. Anomalies of embryological development which aroused only occasionally the curiosity of students of pathology now have become the absorbing interest of many surgical clinics as well as the subject of everyday table-talk and newspaper comment. Such is the power of a ferment. Blalock's (1) bold and well conceived rehabilitation of the cyanotic child with pulmonic stenosis from invalidism to limited activity has caught the public imagination as few things in medicine ever have. And Crawford's courageous excision of the structured area in coarctation of the aorta has won the admiration of all physicians.<sup>1</sup> These technical accomplishments of surgeons have lent exciting interest to the correction of crippling congenital vascular anomalies—and hope to many born to bear the tragic burden of an imperfection in a vital area.

When the history of surgery of this era is written the importance of the stimulus to vascular surgery of Gross's successful interruption of the patent ductus will be generally appreciated. Gross has told the story of previous unsuccessful attempts at ligation of the ductus

and how he worked out the details of the operative approach upon the dog. It perhaps is not without interest to relate here that Dr. George E. Fahr, Professor of Medicine suggested to one of us in 1935 that he considered ligation of the patent ductus a feasible and desirable surgical venture. When the late Elliott Cutler came out from Boston in February, 1935 to give the E. Starr Judd Lecture in surgery at the University of Minnesota Medical School, Doctor Fahr showed us a 2-year-old patient with a large heart and signs of impending cardiac failure from a patent ductus. Cutler, an experienced investigator in cardiac surgery, suggested that a Parham band be placed around the ductus if the operation was undertaken. Probably fortunately for the patient she declined an operation which had not yet then been performed. The first patient selected by Gross for the operation was a child of 7 years. All who have had an experience with the procedure of ligation or division of the ductus can well understand the difference in the surgical problem posed by a child of 7 and a large woman of 22 years with a large heart.

## LIGATION OR DIVISION?

Dissatisfaction with simple ligation of the ductus owing to the circumstance that recanalization occurred now and then persuaded Gross (7) to divide the ductus. This suggestion has been taken up in this clinic too and for the same reason. Dr. M. J. Shapiro who stimulated local interest in this problem following the initial report of Gross and who was responsible for the selection of all the patients for operation in the early stages of the effort here estimates that recanalization occurs in approximately 10 per cent of patients after ligation. Our own experience in this clinic during the period when ligation was done (September, 1939 to November, 1941) is in accord

<sup>1</sup>From the Department of Surgery, University of Minnesota, Minneapolis, Minnesota.

This work was supported by the Scarle Fund for Surgical Research and grant from the Graduate School of the University of Minnesota.

<sup>2</sup>Publications on the surgery of coarctation of the aorta by Gross and Crawford appeared almost simultaneously. The paper of Gross and Huber, appeared in the *New England Journal of Medicine* for September 6, 1945, volume 233, page 257; that of Crawford and N. in *October Journal of Thoracic Surgery* 1945, volume 37, page 347. Gross' first patient was operated upon June 29, 1945. Crawford's on October 19, 1944. Crawford's publication carries the following editorial footnote: Received for publication June 1, 1945.

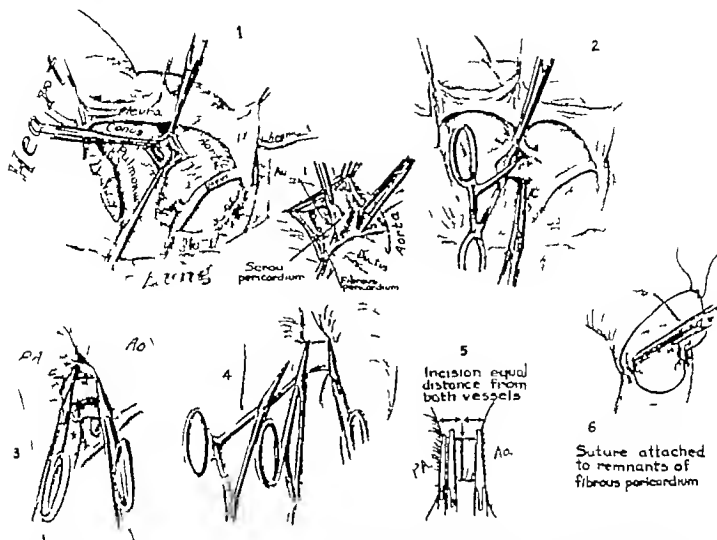


Fig. 2. Surgical division of the ductus. 1 The exposure after division of the mediastinal pleura behind the phrenic nerve. The dissection of the fibrous pericardium overlying the anteromedial angle between pulmonary artery and aorta is commenced. 2 A curved hemostat is pushed through from the outer side of the ductus after a communication has been established between the inner and the outer dissection. The illuminated lucite dissector shown in Figure 3 is a helpful agent in indicating the direction of the dissection in the inner medial angle between pulmonary artery, ductus, and aorta as well as in the final stages of the dissection. The separation of the thick fibrous layer of the pericardium from the thin inner scirous layer is shown in the insert between 3 and 4. Application of hemostats after completion of the dissection. The long hemostat shown in Figure 3a facilitate the operative procedure. 5

The ductus is divided with a knife. Three or four hemostats or clamps may be applied if only three are employed a longer cuff is left on the aortic side as is shown in the diagram. Freeing the fibrous tissue from the adjacent vessel wall enlarges the working distance between ductus, pulmonary artery and aorta such that the hemostats may be placed more readily upon the ductus (see text). 6 The upper clamp has been removed and a running suture of fine silk (No. 0000 or No. 00000) is employed to oversew the cuff. A No. 000 silk suture is anchored in a remnant of the fibrous pericardium just beyond the site at which the clamp grips the vessel wall (that site should be as near the vessel wall as possible, certainly less than 2 millimeters from the grasp of the vessel wall in the clamp). The accurate placement and ligature of this suture insures complete hemostasis.

with such a suggestion. Among 16 patients in which simple ligation of the ductus was done recanalization occurred in 2 patients.

There is by no means however complete unanimity amongst surgeons that division is preferable to ligation. The discussion (9) following a recent paper by Gross (8) in 1947 indicates clearly that some surgeons dissent from the opinion that division of the ductus is

a better operation. Even so experienced and accomplished a thoracic vascular surgeon as Blalock (2) in 1946 appears to favor ligation over division of the ductus. The basis of this difference in attitudes is the circumstance that mere ligation is a simpler and safer operation than division otherwise everyone would agree that division is the safer operation from the standpoint of avoidance of recanalization.

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discerned. Whereas, some separation is permissible by employment of a blunt curved hemostat it is our plan in the main to perform the entire dissection under direct vision using scissors and elevating tissues to be dissected off the wall of the ductus with hemostats. A curved, illuminated lucite elevator or dissector has been very helpful in identifying the plane through which the dissection should proceed. By grasping with a hemostat the areolar tissue (probably remnants of the serous layer of the pericardium) lying directly over the top of the illuminated lucite elevator an opening is made establishing a direct connection between the medial and the lateral portions of the dissection. One of us (O H W) who is partial to this maneuver in completing the dissection employs this technique routinely, frequently switching off all other operating room lights to facilitate identifying and dividing the areolar tissue, at the innermost posterior angle, tipped forward by the illuminated lucite dissector, which has been pushed beneath the ductus from its lateral aspect. Once penetration through the fibrous pericardium surrounding the ductus is achieved, enlargement of that orifice is readily accomplished by elevating and cutting the edges of the adjacent fibrous tissue.

Inasmuch as the wound is often deep long straight narrow hemostats of the Halsted or Rankin pattern have been made up to facilitate division of the ductus (Fig 3a). Four such clamps are placed care also is observed to avoid the recurrent laryngeal nerve with placement of the uppermost clamp on the aortic side and each clamp is pushed home to the last notch on the clamp. The ductus is cut with a knife between the two middle clamps. In the placement of the clamps it is important to have the tip of the clamp just grasp the inner wall of the ductus. Following division a No. 000 silk suture is placed at the inner angle in the remnants of the fibrous pericardium immediately adjacent to the ductus wall at the level of the lower clamp before the upper one is removed. This suture is simply a safety device rarely needed but very convenient to permit elevation of the inner angle should there be any difficulty with subsequent steps in the operative technique. Such a suture is

placed on both the pulmonary artery side as well as the aortic side of the ductus before the upper clamp on each side is removed. The illuminated lucite dissector mentioned previously is an extremely useful instrument too in deciding that the lower clamp on each side actually has the entire vessel wall in its grasp. Should the surgeon have any misgivings on this score the placement of a mattress suture of fine silk (No. 0000) at the inner angle between the upper and lower clamps before the latter is removed will eliminate any potential hazard ensuing from failure to place the lower clamp completely across the arterial wall. Strange as it may seem it is occasionally difficult to decide definitely exactly where the vessel wall ends and where the periarterial fibrous tissue begins. Following the example of Gross we place a running suture of fine silk (No. 0000 or No. 00000) over the remnant or cuff of tissue projecting above the lower clamp. However before removing the remaining clamp an additional stuck tie or horseshoe suture of No. 000 silk is anchored with great care in the remnants of the fibrous pericardium immediately adjacent to the duct wall. As the remaining clamp is removed, this ligature is tightened and tied so that complete hemostasis is insured. The exact placement of this suture requires the greatest care for it is an important item in the safety of division and ligation of the ductus. In the manipulation of the clamps following division of the ductus every one touching a clamp is cautioned to hold it only by one shank or ring thus precluding any inadvertent releasing action occasioned by manipulation of both handles of the clamp.

## RESULTS

Every patient whose patent ductus arteriosus has been interrupted by us since this series of operations began following Gross's publication on division of the ductus has had operative division of the ductus employing the principles of the technique described herein. On several occasions confronted with a wide but short and deeply located ductus in a large subject it has been difficult to resist the temptation of simply ligating the ductus. It is in just such cases however, in which the communication between the aorta and pulmonary

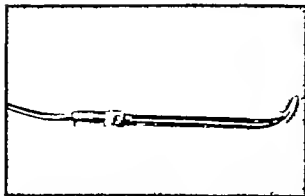


Fig. 2. The illuminated lucite dissector employed to indicate the direction of the dissection as well as the final establishment of communication between the inner and outer dissection. It is attached to a low voltage battery commonly employed for operating room cauteries. During its use the area in which the penetration is to be accomplished may be more readily observed by cutting off temporarily all other sources of illumination.

Certainly no one would approve of simple ligation of an arteriovenous communication in an extremity. The difficulties and hazards of reoperation for patent ductus are even more real than for a peripherally located arteriovenous fistula. Why not take maximal pains therefore to thwart the possibility of recurrence in the first operation?

#### SURGICAL DIVISION OF THE DUCTUS

In 1944 and again more recently in 1947 Gross (7, 8) has outlined the plan of operation for division of the ductus. Since the publication of his first paper upon the technique we have followed his general plan of operation with minor variations. An anterior incision is employed usually obliquely across the anterior chest wall occasionally beneath the breast when it is well developed. The problem of the dissection is not a simple matter particularly in older patients in whom both the heart and the pulmonary artery may be large. Moreover the ductus itself as well as the walls of the adjacent pulmonary artery and aorta is not as tough as the fibrous layer of the pericardium from which it must be separated. This circumstance affords a real handicap in any dissection. And when the tissues to be separated are deeply situated and are conduits for blood the difficulties are apparent. As Gross has indicated when a lapet of pericardium covers the ductus anteriorly only it

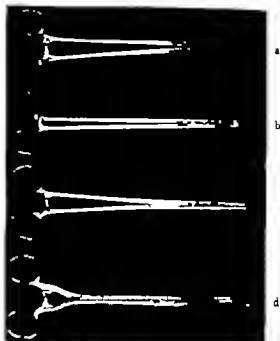


Fig. 3. Other special instruments employed in the dissection: a, A long narrow straight hemostat; b, A long needle holder; c, A curved dissector; d, An ordinary curved clamp (Guyon-Pean) for grasping the kidney pedicle is employed to complete the dissection shown in Figure 2.

may be dissected off. More often than not, however, in our experience the medial wall of the ductus in the plane which must be developed in the dissection between the aorta and the pulmonary artery appears to be well supported by a reflection of the pericardium. Earlier in our experience and especially in adults with large hearts, when the dissection in the anteromedial angle between aorta and pulmonary artery seemed difficult we resorted to the expedient of deliberately opening the pericardial sac over the root of the pulmonary artery, separating the outer fibrous from the inner thinner serous layer of the pericardium. This separation facilitates the dissection. With increasing experience however the necessity for opening the pericardial sac to identify the outer fibrous layer of the pericardium has become very infrequent. Removal of the fibrous layer of the pericardium from the ductus without injury to its wall is essentially the problem posed by the operation. With the fibrous layer of the pericardium removed from the ductus progress in the dissection is readily

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artery is wide that division as contrasted with simple ligation offers the patient the best assurance against recanalization. In the easy case in which the ductus is long ligation may hold out almost as bright a prospect of permanence as division with respect to recanalization. But if division is necessary to protect against the possibility of rechanneling following ligation in continuity why merely ligate in the easy case? There have been 69 divisions of the ductus in this series with 1 death. Recanalization has not occurred.

#### COMPLICATIONS

*Hemorrhage.* In 1 instance in this series one of us (O.H.W.) fell afoul of the inherent difficulties of division. It concerned a large woman (Univ. Hosp. No. 780 697) of 31 years with subacute bacterial endocarditis, auricular fibrillation and cardiac decompression and a large patent ductus. She was a precarious operative risk and had been having chills and fever accompanied by dyspnea, anorexia, and weight loss of 6 months duration. There had also been episodes of pulmonary infarction with hemoptysis and chest pain. The auscultatory cardiac findings were typical of a patent ductus. On examination here multiple petechial hemorrhages were noted in the skin. The patient was cyanotic and dyspneic. The vital capacity was 0.9 liter, there was blood in the urine and the blood urea nitrogen was 90 milligrams per cent. Under penicillin therapy 3,000,000 units per day for 4 weeks the fever which had ranged between 100 and 101 degrees gradually subsided. The patient improved with digitoxin, a salt free diet and small frequent blood transfusions. The advisability of undertaking operation was debated and was undertaken as a last resort measure, no one feeling any real enthusiasm for the procedure. At operation a very broad ductus measuring more than 30 millimeters in width was found. The dissection about the ductus was tedious and difficult, occupying more than 2 hours. It was accomplished however without too much difficulty, the illuminated dissector proving a real help. The urge to terminate the operation by ligation was real. Mindful of the circumstance that it is in just such cases that the greatest hazard of recanalization lies, division

was done. The aortic side of the ductus was dealt with without difficulty. When the stick tie ligature behind the lower clamp on the pulmonary artery side was drawn up however the vessel tore, the bleeding was arrested by digital pressure without too much difficulty and a small hemostat was substituted for digital compression at the site of leak when however ligation of the bleeding point was attempted by placement of another mattress suture the pulmonic end of the ductus tore again. This procedure was repeated four times before hemostasis was complete. It had become quite obvious that a granulomatous process probably involved the vessel wall. Meanwhile the blood loss had been large but had been replaced adequately by blood run in through two intravenous infusion needles placed prior to operation. Fibrillation of the auricles set in followed by cardiac arrest. Ventricular contractions were restarted several times by cardiac massage and epinephrine but effective continued ventricular contractions could not be induced. At autopsy the heart weighed 715 grams. On the aortic side of the ductus in which no special difficulty had been encountered in the operation, 3 or 4 tiny friable vegetations measuring 1 millimeter in diameter were found. In the pulmonary trunk there were several cracks in the intima and there was a large patch of vegetation on the anterior wall of the pulmonary trunk which extended to the left pulmonary artery where it surrounded the origin of the ductus.

The difficulty encountered at operation after division of the ductus is quite understandable in the light of the postmortem findings.

Trying difficulties with hemostasis occurred in only 1 other instance. It concerned a girl of 14 years with pallor in whom a suspicion of subacute bacterial endocarditis had been entertained but not established. She too had a broad short ductus, however the vessel wall held sutures better than the patient referred to previously and the situation though critical turned out happily.

*Fever.* In a young child of 5 years who had been febrile intermittently for months prior to operation, running a fever as high as 101 to 102 degrees Fahrenheit daily in the afternoon

fever continued intermittently for about a month after operation affording us serious concern lest a small cottonoid sponge had been lost in the wound. The fever eventually disappeared entirely. During convalescence too probably, this patient's fever was caused by subacute bacterial endocarditis which diagnosis had not been established definitely prior to operation.

*Pleural fluid.* Aspiration of pleural fluid has been necessary in approximately one third of the patients. Amongst the adults in the series accumulation of pleural fluid has been more frequent than in children. More than one aspiration has been unusual.

*Temporary paralysis of arm.* One patient in the group sustained a temporary paralysis of the muscles of the left hand and forearm supplied by the brachial plexus, undoubtedly owing to inadequate padding of the left axilla.

*Cardiac arrest.* One other patient for whom operation was undertaken for a patent ductus but not completed because of temporary cardiac arrest bears special mention. She was a beautiful child of 4 years (Univ Hosp No 775869). The chest had barely been opened when cardiac arrest occurred. Such grim and tense moments upset the quiet but serious atmosphere of an operation progressing satisfactorily. Differences of opinion and attitudes toward causation as well as mode of management are understandable in such trying conditions. Valuable time was lost in this instance through the insistence of the anesthetist that the vagus nerve should be injected with procaine first, that procaine should be injected into the pericardium and then into the ventricle. All these things were done, the heart muscle being massaged meanwhile, blood also being dripped into an ankle vein. The anesthetist's uneasiness relating to the use of epinephrine concerned his fear that inasmuch as cyclopropane anesthesia had been employed ventricular fibrillation would be induced by epinephrine. One cubic centimeter of epinephrine was then injected into the left ventricle. Effective cardiac contractions began directly. A few minutes later an additional 0.5 cubic centimeter of 1:1000 dilution of epinephrine was given again. The second period was of only a few minutes duration.

The chest wall was closed without attempting dissection or exposure of the ductus. As the final skin sutures were placed cardiac arrest occurred again, oxygen only having been administered by inhalation meanwhile. The chest was opened again and the heart was massaged followed by reinjection of 0.5 cubic centimeter of epinephrine with immediate commencement of ventricular contractions. The anesthetist's record indicated that no blood pressure was obtainable for 45 minutes in the first long period of cardiac arrest.

The cause of the cardiac arrest in this patient has not been uniformly agreed upon. The consensus, however, is that it probably was owing to too high a concentration of carbon dioxide in the alveolar mixture. In other words, anesthetists are sorely in need of agents which will tell them more definitely and promptly from time to time in operations what the likely concentration of carbon dioxide is in the alveolar air.<sup>1</sup>

The more remote occurrences in this patient are equally as interesting. For several days the patient was unconscious, responding only to painful stimuli for a period of almost a week. She also was oliguric, excreting only 15 to 60 cubic centimeters of urine a day with a low specific gravity. During this time she was weighed twice daily, enough 50 per cent glucose solution being given to meet her caloric requirements. After a week's time she showed signs of rousing, accompanied by manifest evidences of irritability. Within 10 days of operation it was apparent that she was aware of the presence of people about her. It was evident that she could hear them. Her speech at this juncture was besitant; she could repeat words and terms of endearment seemed to elicit a suggestion of an earlier familiarity with them, that her memory of certain previous experiences was retained, was evident 3 weeks after operation when asked one morning if she could sing, she sang sweetly and without faltering or hesitation, "Jesus loves me, this I know, for the Bible tells me

<sup>1</sup>As a result of this experience, work is now in progress in this clinic with the help of Dr. A. O. Nier of the Department of Physics and Dr. Allan Flemingway of the Department of Physiology to develop a portable spectrograph to aid the anesthetist in determining the concentration of CO<sub>2</sub> in the alveolar air during operative procedures.

so." Hearing sense of smell and speech appeared to return in that order. While we waited from day to day with mixed feelings of hope and despair for encouraging signs of improvement it had been urged that steps be taken to commit the child to an institution—a suggestion which the parents as well as the surgeons resisted. Four to 5 weeks after operation it was obvious that the child could discern darkness from light. Her speech improved gradually and the movements of her extremities became more co-ordinated. Nine weeks after operation she was dismissed from the hospital returning for occasional observation in the outpatient clinic. Ability to differentiate colors and to distinguish circles from triangles and other evidences of returning vision appeared months after the cardiac arrest. During the past school year the patient made her way to school unaided.

#### SUMMARY

In all operative division of the ductus has been done in 69 consecutive cases.<sup>1</sup> The only death in the series concerned a patient of 31

<sup>1</sup>At the present time (August 10, 1948) 8 additional patients have been operated upon without complication. Ligature rather than division as done in one of them, Mrs. M. M. University Hospital No. 78623, 2, April 22, for this patient had conditions many parallels very much like that reported in the instance of Mrs. G. L. (786607) above. Ligature was done on February 5, 1948 and no evidence of recanalization has appeared.

years with subacute bacterial endocarditis auricular fibrillation and severe cardiac decompensation in whom a granulomatous plaque beneath the pulmonic end of a broad ductus made ligature difficult after division of the ductus. Touroff's suggestion that ligature is a wiser expedient than division in such instances is borne out in this experience.

A technique for dissection and division of the ductus constituting essentially minor variations of the technique described by Gross is detailed herein.

The average postoperative hospital stay save for the patient with a complication has been less than a week.

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# FRACTURES OF THE UPPER END OF THE RADIUS AND ULNA

FRANK D DICKSON M.D. F.A.C.S. Kansas City Missouri

A FRACTURE into the elbow joint is always a threat to the usefulness of this articulation because serious impairment of function so frequently results. The importance of the elbow joint need not be elaborated upon, as it is common knowledge that the loss of or serious interference with, flexion and extension or pronation and supination movements which take place in this joint, may interfere with the ability to earn a livelihood and the performance of many acts necessary to satisfactory and gracious living.

Fractures into the elbow joint numerically comprise an important group, as they make up a considerable portion of the fractures which must be dealt with both in private practice and in large fracture clinics. Supracondylar fractures are the most frequent fractures of childhood and adolescence, and comminuted fractures of the lower end of the humerus are increasing in frequency in the youth and adult groups largely because of the reprehensible habit of driving an automobile with an elbow projecting from the window, a habit which is quite prevalent today. When to these two groups are added fractures of the upper end of the radius and ulna it is evident that there is a rather formidable list of fractures which may be expected to result in some permanent impairment of the function of the elbow joint. Philip Wilson in the *Fracture Oratorion* of 1932 under the title *Fractures and Dislocations of the Elbow*, discussed injuries to this region in a very comprehensive way and left little of importance to be added. The chief emphasis in that analysis, however was placed upon fractures of the lower end of the humerus this presentation which deals only with fractures of the upper end of the radius and ulna should serve to bring into focus the part played by fractures of these elements of the elbow joint

in the production of pathology which causes impairment in its function.

Anatomically by the term 'elbow joint' is meant the articulation between the lower end of the humerus above and the ulna and head of the radius below (Fig 1). The articulation between the ulna and the head of the radius forms the superior radioulnar joint, which does not belong to the elbow joint proper. However the movements of flexion and extension, which take place in the elbow joint, and the movements of pronation and supination which take place between the radius and the ulna centered in the superior radioulnar joint, are so intimately related that from a functional point of view these two joints must be considered as one. The intricate movements the forearm and hand are called upon to carry out are possible only through coordination of the movements of flexion and extension and pronation and supination, and this coordination depends not only upon the proper alignment of the ulna and the head of the radius with the lower end of the humerus but also upon proper alignment between the head of the radius and the ulna. Any disarrangement in these alignments no matter where it occurs, can not fail to impair function in the elbow joint either in the direction of flexion and extension or pronation and supination or both. It is with those fractures of the upper end of the radius and ulna which interfere with the proper alignment of the bones which comprise the functional elbow joint that this discussion is concerned.

The fractures to be considered are (1) fractures of the head of the radius (2) fractures of the olecranon (3) fractures of the upper end of the ulna with dislocation of the head of the radius (Monteggia fracture).

## FRACTURES OF THE HEAD OF THE RADIUS

Fracture of the head of the radius results from a fall on the outstretched hand. When such an accident occurs the elbow is almost

<sup>1</sup>Fracture oration presented before the Clinical Congress of The American College of Surgeons, New York, September 6-11 1937

completely extended and the radius pronated so that the anterolateral section of the head of the radius is driven with considerable violence against the capitellum of the humerus. The damage sustained by the head of the radius depends upon the force of the impact usually it is possible to differentiate three types of fracture of the radial head by roentgenogram (1) a fissure fracture with no or mild displacement (2) a marginal fracture with displacement of a sector of bone (3) a comminuted fracture involving most of the head of the radius

Fracture of the head of the radius should be readily diagnosed as the symptoms complained of are classic these are tenderness over the head of the radius on palpation limitation of extension of the elbow joint with onset of acute pain if extension is even mildly forced, and limitation of pronation and supination with production of pain if these movements are persisted in. While the symptoms enumerated are common to all three types of fracture of the head of the radius, the form of treatment indicated varies with the type to be dealt with this fact must be held constantly in mind in planning the management of radial head fractures.

*Treatment* It is important to remember that a fracture of the head of the radius is not the trivial injury it may appear and that intelligent treatment based on clear roentgenograms carefully studied is demanded if permanent impairment of elbow joint function is to be avoided. Furthermore injury to the cartilage of the capitellum and even fracture of the capitellum the result of the impact of the head of the radius against it and ligamentous damage are complications that not infrequently are associated with this fracture and such possible complications must be considered in any plan of treatment decided upon. For clarity the treatment of each type will be discussed separately.

*Fissure fractures (Fig 2)* The injury is a subperiosteal crack which separates slightly a sector of bone from the radial head usually from its outer border. In young individuals the injury may consist in a tilting of the head on the neck. Although the displacement in this type of fracture is minimal if permitted to

persist an incongruence between the head of the radius and the capitellum will develop and result in permanent limitation of extension and pronation and supination. Such fractures should be treated by supporting the elbow at a right angle in a sling for a week to 10 days to allow the traumatic reaction to subside at the end of this period the sling should be removed four or five times a day and active flexion and extension and pronation and supination carried out by the patient. There should be no passive manipulation or forcible stretching at any time as such maneuvers are likely to cause a serofibrous reaction and the formation of calcareous deposits in the capsule of the joint with permanent impairment of function. On the other hand active movements which the patient himself controls will be guarded and so unlikely to be forced sufficiently to cause an unfavorable reaction. The purpose of daily movement is to mold the distorted radial head to the capitellum while the fracture is still in a plastic state by so doing even if an anatomical reduction is not secured, a satisfactory functioning joint results. At the end of 3 weeks, the sling may be discarded and use continued until healing is complete this usually requires from 8 to 10 weeks. A few degrees of limitation of extension will usually persist but this is not incapacitating.

*Marginal fractures with displacement (Fig 3)* In this type of fracture of the head of the radius a sector of bone usually from the lateral anterior part of the head is depressed and impacted or tilted out of position or completely separated from the main fragment. When the fragment is impacted or tilted out of place but still in contact with the remainder of the head, conservative treatment is indicated. Such conservative treatment is the same as that used in type one namely immobilization of the elbow at right angles for 10 days to 2 weeks preferably in a posterior plaster mold in this fracture for more complete immobilization. At the end of this time the splint may be replaced by a sling and active flexion and extension and pronation and supination movements carried out by the patient five or six times daily. Again it should be emphasized that passive manipulation and forcible stretching are harmful and may lead to permanent interfer-

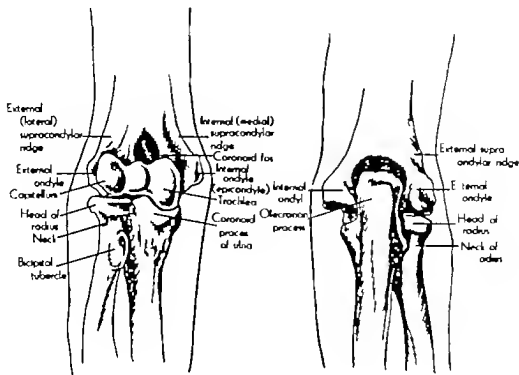


Fig. 1 The elbow and superior radioulnar joints.

ence with function. The same molding of the distorted head to the capitellum is brought about by early guarded movements in this fracture as in type one and an essentially normal range of joint motion will result.

When the fractured off sector is completely separated from the main fragment (Fig. 4) conservative measures should be abandoned and surgery resorted to as ossification of the intervening hematoma produces an irregularly shaped head which will not articulate properly with the capitellum or the ulna and limitation of both flexion and extension and pronation and supination will follow. The surgery carried out depends upon the degree of damage suffered by the radial head. If the fragment is but a small sector and the remainder of the head is intact, simple removal of the loose fragment is all that is necessary. If the fractured sector comprises a large segment of the head (Fig. 5) or if there is any degree of comminution present, the entire head should be resected as arthritic changes will certainly develop later.

When dealing with fractures falling in type 2 it is necessary to make the decision early as to whether they should be treated conservatively or by surgery. If arthrotomy is to be performed and the fragment removed or the head resected, it should be done within 10 days

of the injury. Delay for several weeks will almost invariably give a less satisfactory result with definite impairment of function. As in type 1, some limitation of extension and perhaps slight limitation of pronation and supination are to be anticipated.

*Comminuted fracture of the head of the radius (Fig. 6)* In this type the head of the radius is broken up into a number of fragments which lie loose in the joint or the head is entirely fractured off and completely turned on itself. Conservative measures have no place in the treatment of such fractures as dense adhesions between the fragments and the capsule rapidly form. Excision of the entire radial head is necessary if joint function is to be preserved (Fig. 7). The optimum time for surgery is within 7 to 10 days of the injury; for if surgery is delayed for several weeks or months, limitation of joint motion will already have developed and late removal of the head seldom improves the result.

When the radial head is to be removed, the incision should be placed over the head of the radius posterior to the extensor muscle mass where the field is almost bloodless. The neck of the radius should be cut across cleanly with an osteotome at the level of the upper border of the oricular ligament. The raw surface of

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**Treatment** It is important to remember that a fracture of the head of the radius is not a trivial injury it may appear and that in urgent treatment based on clear roentgenograms carefully studied is demanded if permanent impairment of elbow joint function is to be avoided. Furthermore injury to the cartilage of the capitellum and even fracture of the capsule the result of the impact of the head of the radius against it and ligamentous damage complications that not infrequently are associated with this fracture and such possible complications must be considered in any plan of treatment decided upon. For clarity the treatment of each type will be discussed separately.

**Crack fractures (Fig 2)** The injury is a periosteal crack which separates slightly a sector of bone from the radial head usually on its outer border. In young individuals injury may consist in a tilting of the head of the neck. Although the displacement in this type of fracture is minimal if permitted to

persist an incongruence between the head of the radius and the capitellum will develop and result in permanent limitation of extension and pronation and supination. Such fractures should be treated by supporting the elbow at a right angle in a sling for a week to 10 days to allow the traumatic reaction to subside at the end of this period the sling should be removed four or five times a day and active flexion and extension and pronation and supination carried out by the patient. There should be no passive manipulation or forcible stretching at any time as such maneuvers are likely to cause a serofibrous reaction and the formation of calcareous deposits in the capsule of the joint with permanent impairment of function. On the other hand active movements which the patient himself controls will be guarded and so unlikely to be forced sufficiently to cause an unfavorable reaction. The purpose of daily movement is to mold the distorted radial head to the capitellum while the fracture is still in a plastic state by so doing even if an anatomical reduction is not secured a satisfactory functioning joint results. At the end of 3 weeks, the sling may be discarded and use continued until healing is complete this usually requires from 8 to 10 weeks. A few degrees of limitation of extension will usually persist but this is not incapacitating.

**Marginal fractures with displacement (Fig 3)** In this type of fracture of the head of the radius, a sector of bone usually from the lateral anterior part of the head is depressed and impacted or tilted out of position or completely separated from the main fragment. When the fragment is impacted or tilted out of place but still in contact with the remainder of the head, conservative treatment is indicated. Such conservative treatment is the same as that used in type one namely immobilization of the elbow at right angles for 10 days to 3 weeks, preferably in a posterior plaster mold in this fracture for more complete immobilization. At the end of this time the splint may be replaced by a sling and active flexion and extension and pronation and supination movements carried out by the patient five or six times daily. Again it should be emphasized that passive manipulation and forcible stretching are harmful and may lead to permanent interfer-

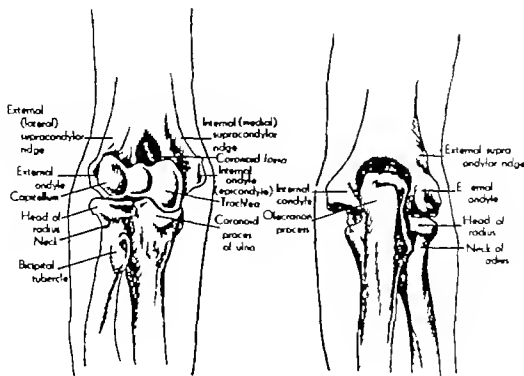


Fig 1 The elbow and superior radioulnar joints.

ence with function. The same molding of the distorted head to the capitellum is brought about by early guarded movements in this fracture as in type one, and an essentially normal range of joint motion will result.

When the fractured-off sector is completely separated from the main fragment (Fig 4) conservative measures should be abandoned and surgery resorted to as ossification of the intervening hematoma produces an irregularly shaped head which will not articulate properly with the capitellum or the ulna and limitation of both flexion and extension and pronation and supination will follow. The surgery carried out depends upon the degree of damage suffered by the radial head. If the fragment is but a small sector and the remainder of the head is intact, simple removal of the loose fragment is all that is necessary. If the fractured sector comprises a large segment of the head (Fig 5) or if there is any degree of comminution present, the entire head should be resected as arthritic changes will certainly develop later.

When dealing with fractures falling in type 2 it is necessary to make the decision early as to whether they should be treated conservatively or by surgery. If arthrotomy is to be performed and the fragment removed or the head resected, it should be done within 10 days

of the injury. Delay for several weeks will almost invariably give a less satisfactory result with definite impairment of function. As in type 1, some limitation of extension and perhaps slight limitation of pronation and supination are to be anticipated.

**Comminuted fracture of the head of the radius (Fig 6)** In this type the head of the radius is broken up into a number of fragments which lie loose in the joint or the head is entirely fractured off and completely turned on itself. Conservative measures have no place in the treatment of such fractures as dense adhesions between the fragments and the capsule rapidly form. Excision of the entire radial head is necessary if joint function is to be preserved (Fig 7). The optimum time for surgery is within 7 to 10 days of the injury, for if surgery is delayed for several weeks or months, limitation of joint motion will already have developed and late removal of the head seldom improves the result.

When the radial head is to be removed, the incision should be placed over the head of the radius posterior to the extensor muscle mass where the field is almost bloodless. The neck of the radius should be cut across cleanly with an osteotome at the level of the upper border of the orbicular ligament. The raw surface of



completely extended and the radius pronated so that the anterolateral section of the head of the radius is driven with considerable violence against the capitellum of the humerus. The damage sustained by the head of the radius depends upon the force of the impact usually it is possible to differentiate three types of fracture of the radial head by roentgenogram (1) a fissure fracture with no or mild displacement (2) a marginal fracture with displacement of a sector of bone (3) a comminuted fracture involving most of the head of the radius.

Fracture of the head of the radius should be readily diagnosed as the symptoms complained of are classic these are tenderness over the head of the radius on palpation limitation of extension of the elbow joint with onset of acute pain if extension is even mildly forced and limitation of pronation and supination with production of pain if these movements are persisted in. While the symptoms enumerated are common to all three types of fracture of the head of the radius the form of treatment indicated varies with the type to be dealt with this fact must be held constantly in mind in planning the management of radial head fractures.

*Treatment* It is important to remember that a fracture of the head of the radius is not the trivial injury it may appear and that intelligent treatment based on clear roentgenograms carefully studied is demanded if permanent impairment of elbow joint function is to be avoided. Furthermore injury to the cartilage of the capitellum and even fracture of the capitellum the result of the impact of the head of the radius against it and ligamentous damage are complications that not infrequently are associated with this fracture and such possible complications must be considered in any plan of treatment decided upon. For clarity the treatment of each type will be discussed separately.

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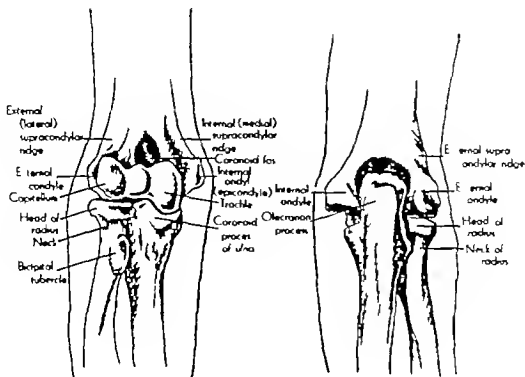


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of the injury. Delay for several weeks will almost invariably give a less satisfactory result with definite impairment of function. As in type 1, some limitation of extension and perhaps slight limitation of pronation and supination are to be anticipated.

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When the radial head is to be removed, the incision should be placed over the head of the radius posterior to the extensor muscle mass where the field is almost bloodless. The neck of the radius should be cut across cleanly with an osteotome at the level of the upper border of the orbicular ligament. The raw surface of

the neck should be covered with a flap comprised of stripped back periosteum or flaps dissected from surrounding soft tissues to seal it off and to prevent proliferative changes at this point. The most frequent error made is failure to resect far enough distally. When this error is made the expanded part of the neck is left behind and adhesions between it and the ulna frequently form and limit pronation and supination. Placing the incision too far forward brings it near the posterior interosseous nerve damage to which will result in wrist drop.

#### FRACTURES OF THE OLECRANON

Fractures of the olecranon may be caused by direct violence such as a fall or blow on the tip of the elbow or by indirect violence in the form of forcible flexion of the elbow against the strong resistance of the powerful triceps muscle. Some fractures of the olecranon result in slight or no separation of the fragments (Fig 8) such fractures cause little disturbance in the elbow and present no problem in treatment. When however there is separation of the fragments or even as little as one-fourth inch a definite problem in treatment is involved (Fig 9). With displacement of the proximal fragment the triceps tendon which is attached to it is relaxed and loses its power to extend the elbow actively. Permanent relaxation of the triceps tendon which must occur unless the fragments are brought into contact and a firm bony union secured will result in continuing weakness of active extension of the elbow which prevents reaching for objects above the shoulder level and weakens the ability to push against resistance. If the fragments are not brought into apposition and a fibrous union occurs, degenerative arthritic changes in the articular cartilage of the elbow joint may be anticipated and limitation of flexion and extension will occur in a very considerable percentage of cases. Even if bony union takes place in spite of separation of the fragments an incongruence of the joint surface develops and serious limitation of flexion and extension is the usual outcome. It may be stated then that fractures of the olecranon like fractures of the head of the radius can not be considered to be trivial injuries but on the contrary may lead to serious disability in the elbow joint.

*Treatment* There are two objectives to be sought for in treatment of fractures of the olecranon (1) the restoration of normal length and tension of the triceps muscle so that it may function properly (2) the securing of a normal contour of the upper end of the ulna, which must articulate accurately both with the trochlear surface of the humerus and the olecranon fossa, into which the olecranon fits when the elbow is extended, if normal function is to be restored. Unless both these objectives are attained, normal or even useful elbow function will be jeopardized.

Fractures of the olecranon without separation can be dismissed with brief comment. If flexion of the elbow does not cause separation of the fragments, the elbow should be treated by immobilization in a posterior plaster mold in right angle flexion. If flexion causes even the slightest separation the fracture should be treated in extension in an anterior plaster mold extending from the axilla to the palm. If the extended position is necessary it is desirable to initiate flexion movements as early as possible but such movements should not be started too early. Many advise starting flexion in 3 weeks our experience however has been that this is too early and that 5 weeks is as soon as flexion exercises should be carried out. Separation of the fragments with disastrous results has occurred in several cases which have come under our observation in which early motion had been insisted upon. Recovery of motion should be achieved by active movements carried out by the patient. Passive movements and forcible stretching are contraindicated because of the danger of setting up a fibrosis in the capsule. Ample time should be allowed for recovery as some limitation of movement may persist for 8 or 10 months.

Fractures of the olecranon with separation of the fragments present quite a different problem in treatment. Restoration of length and tone to the triceps muscle and proper modelling of the upper end of the ulna must be attained to insure a satisfactory outcome. If extension of the elbow and manipulation of the proximal fragment do not result in perfect apposition, surgery must be resorted to in practically all cases. One other method of closed reduction



Fig. 2



Fig. 3



Fig. 4



Fig. 5



Fig. 6

Fig. 2 Fissure fracture of the head of the radius, no displacement (Type 1)

Fig. 3 Marginal fracture of the head of the radius. Type 2 suitable for conservative treatment.

Fig. 4 Marginal fracture of the head of the radius, type 3 fractured fragment should be removed

Fig. 5 Marginal fracture of the head of the radius, type 2 head should be resected if fractured segment is large or comminution is present.

Fig. 6 Comminuted fracture of the head of the radius, type 3 entire head should be resected if joint function is to be preserved

and immobilization may be employed when the olecranon fragment is large (Fig. 10). In this method the fragment is transfixed with a Steinmann pin and levered into position. After reduction has been accomplished the pin is driven down into the ulna a sufficient distance to anchor firmly the fragment in position. A plaster cast should then be applied with the elbow at right angles. The end of the Steinmann pin is allowed to project through the cast and fixed in position with a few turns of plaster. When this method is used the alignment of the fracture should be checked by fluoroscope or roentgenograms before the pin

is driven home in the ulna. Our experience indicates that the pin should be driven into the ulna in such a way as to engage the cortex of the bone rather than pass down in the medullary canal as better fixation is secured. Plaster fixation should be maintained for 5 weeks after which time the pin may be removed and active exercises started. This form of treatment has given satisfactory results in 5 cases in which it was used and unsatisfactory results in 3 cases. The method is not without drawbacks and should be used only in selected cases. Frequent check of position by roentgenogram should be made during the first 2 weeks. The

the neck should be covered with a flap comprised of stripped back periosteum or flaps dissected from surrounding soft tissues, to seal it off and to prevent proliferative changes at this point. The most frequent error made is failure to resect far enough distally. When this error is made the expanded part of the neck is left behind and adhesions between it and the ulna frequently form and limit pronation and supination. Placing the incision too far forward brings it near the posterior interosseous nerve damage to which will result in wrist drop.

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Fig. 2.



Fig. 3



Fig. 4



Fig. 5



Fig. 6

Fig. 2. Flange fracture of the head of the radius, no displacement (Type 1).

Fig. 3. Marginal fracture of the head of the radius, Type 2, suitable for conservative treatment.

Fig. 4. Marginal fracture of the head of the radius, type 3, fractured fragment should be removed.

Fig. 5. Marginal fracture of the head of the radius, type 3, head should be resected if fractured segment is large or comminuted is present.

Fig. 6. Comminuted fracture of the head of the radius, type 3, entire head should be resected if joint function is to be preserved.

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Fig. 7a



Fig. 7b



Fig. 8



Fig. 9



Fig. 10



Fig. 11

Fig. 7 a, Head of radius fractured completely off b head has been resected correct level

Fig. 8 Fracture of olecranon without displacement

Fig. 9 Fracture of olecranon with displacement

Fig. 10 Stehmann pin used to reduce and fix fracture

of the olecranon. The head of the radius has been resected

Fig. 11 Unsatisfactory result of Stehmann pin fixation in case shown in Figure 9. Arthritic changes and definite limitation of motion, unsuitable case because of a fractured fracture of the head of the radius

unsatisfactory results were those in which arthritic changes occurred with definite limitation of motion (Fig. 11).

Practically all fractures of the olecranon with separation are best treated by surgery since active extension of the elbow can be expected only if the triceps is re-united to the ulna without lengthening of its tendon and normal flexion and extension only with accurately fitting joint surfaces in the hinge between the ulna and the trochlea of the humerus and accurate seating of the olecranon in the olecranon fossa. The normal length and tone of the triceps can be restored by one of two surgical procedures: (1) open reduction of the fracture with the use of internal fixation so that bony union in perfect position will result or (2) by exci-

tion of the olecranon fragment and reattachment of the triceps tendon with its lateral aponeurosis to the upper end of the ulna.

When open reduction is chosen fascia lata should be used as the fixation material. Fine stainless steel wire may be used but screws and nails are less desirable because of the early and late tissue reaction which they may excite. The fracture is exposed and cleaned of all interposing tendon fibers which may have fallen between the fragments and interfere with bony contact. A hole should be drilled transversely in the distal fragment of the ulna and a suture passed through the drill hole and around the proximal fragment engaging the entire triceps insertion in which it is buried (Fig. 12). This suture should cross over the fracture so that



Fig 12

Fig 12. Open reduction of fracture of the olecranon with fascia lata suture used, single drill hole.

Fig 13. Open reduction of fracture of the olecranon, stainless steel wire used as suture. Crossing suture to prevent displacement is shown as well as extra suture running from fragment to fragment.

Fig 14. a. Compound, comminuted fracture of the olecranon. b. wire and single screw used for fixation because of comminution with malalignment and limitation of motion. c. later resection of the olecranon with restoration of practically normal range of motion.



Fig 13.

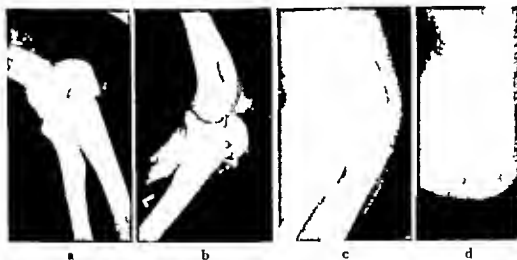


Fig 14

when tied it will approximate the fragments and prevent tilting and lateral displacement. If the olecranon fragment is large it is better to drill a tunnel through each fragment and add a second suture passing directly from drill hole to drill hole (Fig 13). The elbow should

then be gently flexed to about a right angle and the position of the fragments carefully checked to see that accurate reduction is maintained. The elbow should be immobilized in plaster at right angles for 5 to 6 weeks. Active movement is carried out as in the closed method.





Fig. 7a



Fig. 7b



Fig. 8.



Fig. 9.



Fig. 10.



Fig. 11.

Fig. 7. Head of radius fractured completely off. Its head has been resected. Correct level.

Fig. 8. Fracture of olecranon. About displacement.

Fig. 9. Fracture of olecranon. About displacement.

Fig. 10. Steinmann pin used to reduce distal fracture

of the olecranon. The head of the radius has been resected.

Fig. 11. Unsatisfactory result of Steinmann pin fixation in case shown in Figure 10. Arthritic changes and definite limitation of motion, an unsatisfactory case because of associated fracture of the head of the radius.

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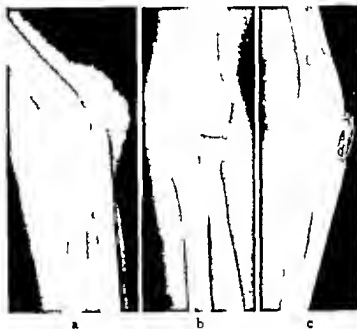


Fig. 13.



Fig. 4

when tied it will approximate the fragments and prevent tilting and lateral displacement. If the olecranon fragment is large it is better to drill a tunnel through each fragment and add a second suture passing directly from drill hole to drill hole (Fig. 13). The elbow should

then be gently flexed to about a right angle and the position of the fragments carefully checked to see that accurate reduction is maintained. The elbow should be immobilized in plaster at right angles for 5 to 6 weeks. Active movement is carried out as in the closed method.



Fig. 5. Proximal resection of proximal fragment. No malfunction in 8 weeks.

Excision of the olecranon fragment is, in our experience, a much simpler and more certain method of treating fractures of the olecranon with separation than is open reduction. Even with accurate reposition, malalignment of the proximal fragment may develop in the course of healing (Fig. 14). This displacement may prevent the tip of the olecranon from seating properly in the olecranon fossa and limited extension follow. Degeneration of the articular cartilage on the ulna and even on the trochlea may take place; the result of the trauma suffered at the time of injury, and such degenerative changes produce a traumatic arthritis in the elbow joint with limitation of flexion and

extension although alignment may be perfect is maintained. When the olecranon fragment is excised, all danger of any incongruence between the olecranon and the olecranon fossa is removed, and the danger of traumatic arthritis due to degenerative changes in the articular cartilage of the ulna is eliminated. Return of normal flexion and extension movements takes place rapidly, and the convalescent period is markedly shortened (Fig. 15).

The essential part of the operation is not the excision of the olecranon fragment but reattachment of the triceps tendon. The fragment should be shelled out by close sharp dissection preserving all attachments of the triceps tendon. Two drill holes should be made in the proximal end of the ulna. Mattress sutures of fascia lata are placed in the triceps tendon and passed through the drill holes in the ulna, firmly anchoring the tendon to bone. Additional fixation is secured by suturing with catgut the lateral margins of the triceps tendon to the fascia on each side of the ulna. The elbow should be immobilized in plaster at right angles for 10 days to 2 weeks, and then active exercises should be carried out to restore use which will usually return rapidly. There is no danger of forward displacement of the ulna even if quite a large fragment must be removed, as the strong triceps muscle prevents this. Only failure to reattach the triceps tendon properly and adequately will allow forward displacement to occur. We have found resection so satisfactory that it is used routine-



Fig. 6. Typical Monteggia fracture of the ulna, with illustration of the head of the radius.



Fig. 7. Atypical Monteggia fracture, really an anterior dislocation of the elbow.



Fig. 18 Unreduced Monteggia fracture with extensive disability

ly in our clinic unless there are complicating factors which make it undesirable

#### MONTEGGIA FRACTURES

Fracture of the upper end of the ulna with dislocation of the head of the radius first described by Monteggia a century ago is one of the most disastrous fractures which occurs about the elbow joint so far as impairment of elbow function is concerned. Statistics indicate that in approximately 90 to 95 per cent of cases permanent disability of a high grade follows this fracture. The typical Monteggia fracture (Fig. 16) of the ulna occurs 3 to 4 inches below the olecranon but the line of fracture may lie closer to the joint (Fig. 17). The solution in the continuity of the ulna is complicated by rupture of the orbicular ligament and dislocation of the head of the radius. Satisfactory reduction and maintenance of reduction of the fracture of the ulna are difficult

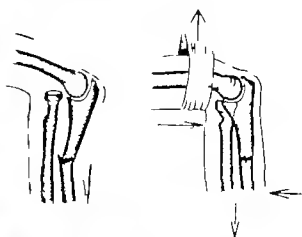


Fig. 19 Diagram of method of closed reduction of Monteggia fracture



Fig. 20 The result of inadequate internal fixation wire loop failed to hold fracture in place.

so that malunion is frequent and extensive damage to the orbicular ligament often makes it impossible to maintain the head of the radius in position after it is reduced. Malunion of the ulna and permanent dislocation of the head of the radius mean an elbow joint in which both flexion and extension and pronation and supination will be permanently limited and to a serious extent (Fig. 18).

*Treatment* A Monteggia fracture of the usual type is reduced by flexing the elbow apply



Fig. 21



Fig. 22

Fig. 21 Adequate fixation of fracture of ulna head of radius apparently reduced  
Fig. 22 Same fracture as shown in Figure 21 a weeks later showing redisplocation of head of the radius.



Fig. 1 Late resection of the head of the radius in Monteggia fracture with practically normal function

ing traction and manipulation (Fig. 19). Unfortunately these maneuvers give a satisfactory reduction of the fracture of the ulna and replacement of the dislocation of the head of the radius in comparatively few cases and in these there is a strong tendency toward displacement. Very few Monteggia fractures are successfully reduced by manipulation and open reduction with internal fixation is demanded from the start. The fracture should be exposed accurate reduction secured and the fragments immobilized with an adequate bone plate (Fig. 20). Perfect reduction of the ulnar fracture will as a rule bring about replacement of the dislocated head of the radius (Fig. 21). If the head of the radius fails to reduce it should be manipulated into place; it should not be exposed and open reduction and repair of the orbicular ligament undertaken. Open replacement of the dislocated radial head if carried out at the same operation as plating of the ulna almost invariably leads to ankylosis or limitation of motion in the upper radio-ulnar joint because of ossification about the head and neck of the radius which usually follows. Watson Jones considers this ossification to be due to the deposit of calcium in the hematoma disseminated into the muscles and ligaments by surgical interference. If the displacement of the head of the radius can not be corrected by reduction of the ulna and manipulation it should be allowed to remain displaced and 2 or 3 months later the head should be resected. Contrary to what occurs in fractures of the head of the radius late removal of the dislocated radial head gives excellent function as regards flexion and extension and pro-

nation and supination. In a certain number of cases the head of the radius will replace when the ulna is brought into alignment but within a few days or a week or two it will redislocate because the orbicular ligament fails to repair itself (Fig. 22). When this complication occurs, it is best to do nothing about it for 2 or 3 months and then resect the radial head (Fig. 23). There are many with wide fracture experience who prefer to reconstruct the orbicular ligament rather than resect the head of the radius; if this is done it should be postponed for at least 2 months as is resection of the head and for the same reason. In our experience late resection of the radial head has given more satisfactory results than attempts to reconstruct the orbicular ligament as it is rarely possible to anchor the head of the radius securely in place by an artificial ligament and the radioulnar joint is so relaxed that it may be unreliable painful and later develop arthritis.

The elbow joint from childhood is vulnerable to injury. The mechanics of the functional elbow joint are so complex that any injury which interferes with the proper alignment of its component parts can cause impairment of function of serious degree. Because this is so fractures which involve the upper end of the radius and ulna important elements in the joint demand careful appraisal and the selection of that form of treatment which will insure restoration of the most advantageous relations between the articular surface of the ulna, the head of the radius, and the lower articular surface of the humerus. Anatomical alignment is important but a satisfactorily functioning elbow joint is more so and restoration of function must be the aim of treatment. The first step to this end is understanding that no fracture which enters the elbow joint is a trivial injury but one which carries with it the possibility of permanent impairment. The second step is never to overlook the susceptibility of the elbow joint to form adhesions and so avoid in the after treatment of elbow fractures including those of the upper end of the radius and ulna the use of passive motion and forceful manipulation which promote the formation of adhesions and these always result in limitation of movement in one or more directions with varying degrees of disability.

# ONL HUNDRED CASES OF CONGINITAL ABSNCE OF THE VAGINA

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**T**he primary purpose of this article is to compare the various methods of surgical treatment for congenital absence of the vagina. During the course of time many procedures have been utilized with varying degrees of success but only relatively recently has an entirely satisfactory method been employed which is simple, entails minimal morbidity and mortality and produces a high percentage of good results.

We are including 14 operations done according to the Baldwin technique, 1 according to the Falls method, 1 of iodoform gauze packing, 70 McLeod procedures in which split skin grafts are employed and 14 operations performed according to the technique popularized at the clinic by one of us (V. S. C.) which consists of simple dissection and insertion of a mold. Data on 76 of these cases were presented by the senior author (V. S. C.) at the meeting of the American Medical Association at Atlantic City, New Jersey, June 9 to 14, 1947.

## EMBRYOLOGY

Development of the vagina varies from partial to total. This structure is derived from the (1) muellerian ducts (18-32), (2) wolffian ducts and (3) urogenital sinus (29-37-40-51). Numerous microscopic sections made on human embryos during growth have materially aided embryologists. At 8 millimeters the muellerian ducts appear as an evagination of the celomic cavity lateral to the upper portion of the wolffian ducts. The caudal portion of the muellerian ducts forms a tube with a solid tip which burrows itself through the mesenchyme of the urogenital fold crossing the wolffian ducts anteriorly and at the caudal end of the mesonephros. At 30 millimeters the caudal tips of the muellerian ducts fuse and reach the posterior wall of the urogenital sinus

pushing it forward and forming the muellerian tubercle. With the distal fusion of the muellerian ducts the uterovaginal canal is formed. The wolffian ducts have kept pace with the muellerian system but at 56 millimeters begin showing signs of involution. Approximately at this time there is a great intermingling of cells of the urogenital sinus, wolffian ducts and muellerian ducts and here is where controversy persists as to what group of cells proliferates to predominate in the formation of the vagina. At 63 millimeters the muellerian tubercle gives way to the bilateral sinovaginal bulbs formed by the evagination of the posterior wall of the urogenital sinus. The growing of the sinovaginal bulbs and the transformation of the columnar epithelium to stratified epithelium of the lower portion of the uterovaginal canal results in the formation of a primitive vaginal plate. The vaginal plate increases in size and proliferating cells invade the surrounding mesenchyme. The epithelial activity begins at the caudal end. This proliferation forms a solid vaginal cord. The cells in the center of the solid cord undergo involution and desquamation thereby forming the vaginal canal which first appears in embryos of 150 to 200 millimeters trunklength. This canal communicates with the cervical canal above and the hymenal foramen below (43).

## SURGICAL PROCEDURES USED IN RECONSTRUCTING AN ARTIFICIAL VAGINA

**Bowel transplants.** In this country when a portion of bowel is to be used as the new artificial vagina the Baldwin technique has been favored most. In 1904 Baldwin (3-4) described a method for using the ileum as a transplant but did not have a chance to try it until 1907. The method proposed was to excise a loop of ileum 10 inches long (25 cm.) and to reunite the bowel by an end-to-end anastomosis. He then dissected between the bladder

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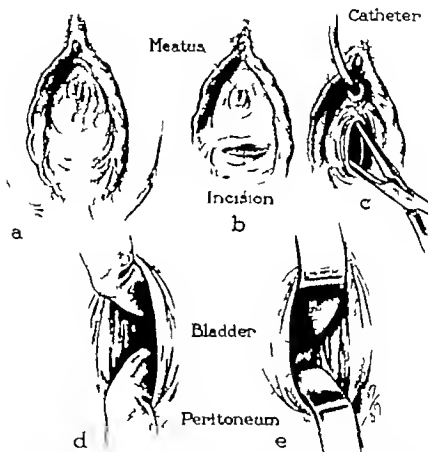


Fig. Construction of an artificial vagina. a, Absence of evidence of vagina; b, transverse incision to new slit of vagina; c, dissection of the urethra; d, tissue separated by blunt forceps to locate the fascial plane between the bladder and rectum; e, bladder and rectum being carefully separated with the fingers, peritoneum of the cul-de-sac being elevated by retraction to secure depth for new vagina. (From Counseller V. S. Congenital anomalies with particular reference to cryptorchidism, hypospadias and congenital absence of vagina. *J. Michigan M. Soc.* 938, 37: 689-697. Vol. 4, p. 696.)

and rectum using a perineal approach pulled the middle of the isolated loop downward attached the upper end of the loop around the cervix and closed the other end. The abdomen was then closed. With the patient in the lithotomy position and the loop of bowel held in forceps the bowel was opened up, cleansed, each limb was packed with iodoform gauze and the edges of the bowel were attached to the surrounding bymenal margins. After 2 weeks a clamp was placed on the double barreled septum converting the two loops of bowel into one canal. In 1910 this procedure was modified by Mori, who used only one loop of bowel sutured to the vaginal introitus.

Previously, the rectum had been employed in repair of this condition as reported by Snegureff in 1892, who made an incision from the coccyx to the anus and separated the rectum from the coccyx, which was excised. The intestine was ligated in two places and divided. The superior segment was sutured to the right of the coccygeal region and the inferior segment was brought down and its upper end closed. Two weeks later a second stage was done, in which the perineum was incised and the rectal mucous membrane was sutured to the adjacent parts. In 1910 Popow and in 1911 Schubert utilized methods similar to those used by Snegureff.

**Labial grafts.** The first to use labial grafts to form an artificial vagina was Jewett in 1904, but Graves popularized this method in 1908 using two labial flaps and two thigh flaps over a glass form. When the skin pouch was almost completely sutured, the glass form was removed and the flaps invaginated and sutured to the depths of the vault. Davis and Cron modified Graves's method by using only labial flaps and by making their original perineal incision vertically rather than transversely. Falls in 1940 cut a disc 2 to 3 centimeters in diameter around the introitus, then undercut the edges and pushed the disc back by blunt dissection. Four skin flaps from the vulval opening were taken and their free end was sewed to the edges of the disc. This skin lined cavity was packed with gauze daily with moderate pressure until healing was complete. Meigs suggested tunneling between the bladder and rectum and then leaving a mold in place for 6

to 12 months, after which internal grafting according to the Graves method is carried out.

**Grafts from thigh.** In 1900 Beck reported use of skin flaps from the thigh after he had opened a tract between the bladder and rectum using both abdominal and perineal incisions. All the dissection was done extraperitoneally and after the passage which was created by the perineal approach met the prevesical space two skin flaps from the thigh were seized by forceps introduced through the superior abdominal opening, drawn up and sutured to the depth of the newly created vault. The vagina was then packed with iodoform gauze.

Frank and Geist (22) in 1927 modified the procedure. They outlined a flap along the inner surface of the thigh. The raw edges were turned in over a tube. Two weeks later the distal end of the tube graft was partially incised. A little later a canal was established by blunt dissection in the rectovesical septum, the distal end of the tube graft was completely separated and the graft was turned inside out with the skin inside over a vaginal plug. This graft was then sutured to the depth of the vault. Eight days later the proximal end of the original flap was completely separated from the donor area and the cut edges sutured to the vulval margin.

Grad in 1932 used several steps to swing his graft and the mold was not used until the procedure was completed. He resorted to split skin grafts to repair any resultant defects.

**Free skin grafts.** Heppner in 1872 made the first attempt to use this method but apparently without much success. Flynn, according to Flynn and Duckett, in 1915 used free skin grafts from the external genitalia to line the vaginal tract. An excellent result was obtained after repeated dilatations. In 1930 Kirschner and Wagner used a rubber sponge prosthesis covered with Thiersch grafts. The vaginal tract was drained by a rigid rubber tube which was inserted through the sponge. In 8 to 10 days the sponge was removed and dilatations were begun. In 1938 McIndoe and Banister reported a case of the satisfactory use of a Thiersch graft over a vaginal mold which was left in place 3 to 6 months until the contractile phase of the grafting process was



over. Emphasis was placed on long-continued use of the mold. Bonney and McIndoe in 1944 were able to establish regular menses in a girl with a bicornate uterus and no cervix by joining the two halves of the uterus over a mold with a graft. Each of these authors has done the operation in about 30 cases. In 1944 Counseller and Sluder reported 35 such cases.

**Simple pressure.** In 1938 Frank (21) found that operation to create an artificial vagina was unnecessary in some instances. Frank's method was modified in 1940 in such a way that dilatation was accomplished by manual pressure of graduated tubes inward against the perineum one half hour twice a day. Progress was noted in weekly office visits the first month and in semimonthly visits the second month. This, then, establishes a permanent vagina which sometimes attains a depth of 3½ inches (8.9 cm). Steinmetz in 1940 reported a case in which this method was used. In 1941 Campbell found that he could lengthen the vagina to 3 inches (7.6 cm) in 2 to 4 weeks by this method. He used catlin pessaries at night for the raw areas in the vagina. Dawson in 1945 got a satisfactory result in 1 case by the method of Frank in which the vagina attained a depth of 3¼ inches.

**Simple reconstruction.** In some instances simple pressure is not sufficient for a satisfactory result; however a very simple surgical procedure has been devised which consists simply of tunneling in the rectovesical septum using mainly blunt dissection and then allowing the epithelial buds in the tract to proliferate and line the new vagina (Fig. 1). The vaginal canal remains patent as a result of the extended use of a vaginal mold. This method has now been used at the clinic in 14 cases. It was tried unsuccessfully as long ago as 1817 by Dupuytren who used tampons in the tract to maintain patency. In 1935 Wells gave impetus to the simple surgical procedures when he used only petrolatum gauze which was changed every 2 days, to maintain patency in the dissected vaginal tract. Hunter in the same year used iodoform gauze for 10 days, after which a dilator was worn for a time. The results in both cases were good.

In 1938 Wharton (53) used a mold made of paraffin or balsa wood covered with a condom.

One patient had been treated 10 years previously with an excellent result; the other patient would not report after 1 month. Wharton ventured the opinion that the epithelium from the lower third of the vagina (urogenital sinus) formed a large part of the epithelium of the upper two-thirds of the vagina (müllerian ducts). In 1946 Wharton (54) published reports of cases in which he used a Thiersch graft over the mold. This was done in order to hasten epithelialization so as to avoid relying on the proliferative powers of the vaginal epithelial buds; also by this procedure a decrease in the formation of scar tissue could be obtained. In that communication 16 cases were reported from Johns Hopkins. Miller Willson, and Collins have used molds with and without Thiersch grafts and they have expressed preference for the latter method because in those cases in which it was used the vagina seemed softer, more pliable, and better epithelialized. Grafts were employed in 11 of their 17 cases. Twenty seven cases in which the dissection, no graft technique was used with good results have been reviewed by Wells, Word, Emge and Miller and co-workers.

**Miscellaneous procedures.** Tissue from various sources has been relied upon to form a lining for the prepared vaginal tract with varying degrees of success. Among these are Douglas transplants of peritoneum (50), amniotic membranes (8), vernix caseosa (31), hernial sac (1), and heterogeneous vaginal transplants (34).

Some surgeons do not prefer one method exclusively and use several of the previously described procedures. Sadler in 1941 reported 3 cases in one of which the vagina was made by the husband in his attempts at coitus, in another of which only simple pressure was required to dilate the canal, and in the third of which a Thiersch graft over a mold was used. In 1945 Brady presented 4 cases in the first case the Graves method was used; in the second a modified Graves technique was followed; in the third Wharton's technique was employed and in the fourth only dilatation without operation was required.

#### ANALYSIS OF CASES

**Incidence.** In 1572 this condition was described by Realdus Columbus. According to

Engstadt, vaginal aplasia occurs once in 5 000 births. Owens found only 6 cases in 125,000 female hospital admissions. The incidence in our series was 1 case of congenital absence of the vagina in every 4,000 female patients.

**Age.** Of the 100 consecutive patients seen at the clinic with congenital absence of the vagina who underwent surgical correction, the ages varied from 14 to 49 years. Sixty-four of the patients were within the age range of 17 through 26 years, the average being 23 years for the entire series.

**Family history.** Ninety-six patients gave a negative family history. One patient had a sister who had amenorrhea, another had a sister with amenorrhea and infantile genitalia, still another had a sister who menstruated only twice a year, and a fourth had a sister who had congenital absence of the vagina.

**Menstrual history.** Ninety-nine of the patients gave a history of amenorrhea. One patient had normal menses except that the flow was through the urethra and one had vicarious menses through the lungs and rectum. Ninety of the patients became aware of their condition after they had consulted their physician because of amenorrhea. Ten patients were not disturbed by the amenorrhea but complained of inability to have intercourse. Of the 99 patients with amenorrhea, 34 complained of periodic (usually monthly) cramps in the lower part of the abdomen. These cramps were occasionally severe and were the initiating factor in causing the patient to seek medical advice.

**Physical findings.** Of the 100 patients with congenital absence of the vagina, 2 had infantile external genitalia and no pubic hair. In 61 patients the medical examiner was unable to palpate tubes, ovaries, or uterus, but because of the secondary sexual characteristics, it seemed that some ovarian tissue was undoubtedly present. In 10 of the 61 patients estrin levels in the urine were determined and found to be normal. In 19 patients tubes, ovaries, and uterus were palpable. In 9 patients the uterus alone was palpable. In 9 patients tubes and ovaries alone were palpable. In 2 patients ovaries alone were palpable. The psychologic attitude and emotional stability were normal in 88 of the patients, fair in 4, and poor in 8.

**Abnormalities other than genitourinary.** One patient had a congenitally dislocated hip and malformed foot, arm, and ribs; 1 had spina bifida occulta; 1 had a left hemivertebra; 1 had a rudimentary first rib; and 1 had a cervical spina bifida and a pelvic kidney. One patient had excessive hair on her chin, hypertension, and was obese, but was not considered to have Cushing's syndrome. One patient had sacralization of the fifth lumbar vertebra.

**Urologic findings.** Forty-one patients underwent a urologic examination consisting of an excretory urogram and, when indicated, a retrograde pyelogram and cystoscopic examination. Twenty patients had a normal urinary tract. Twenty-one patients were found to have abnormalities of the urinary tract, of whom 7 had pelvic kidneys, 5 had solitary kidneys, 4 had a duplicated ureter or renal pelvis, 2 had pyelo-ureterectasis, 1 had a malfunctioning kidney, 1 had a solitary fused kidney, and 1 had had nephrectomy on the right for unstated reasons. Ten patients had abnormalities on the right side, and 11 patients had abnormalities on the left side.

**Surgical findings.** Twenty-six patients underwent pelvic operations which permitted the visualization of the pelvic organs. Of these, 4 patients had anatomically normal tubes, ovaries, and uterus; 3 had hematosalpinx; 3 had endometriosis; and 10 had normal tubes and ovaries but a malformed uterus (6 infantile uterus, 2 bicornuate uterus, 1 unicornate uterus, and 1 instance of cervical atresia with bilateral hematosalpinx). Five patients had normal tubes and ovaries but no uterus. One patient who had no tubes, ovaries, or uterus had vicarious menses through the lungs and rectum.

Ten additional patients underwent inguinal herniorrhaphy. In 7 of these patients the hernial sac contained an ovary. In 1 patient the hernial sac contained a testis and in another it contained an ovotestis and epididymis (proved microscopically). The contents of one hernial sac was not stated.

Twenty-four patients had previously undergone minor vaginal plastic procedures consisting chiefly of hymenotomy. One patient had undergone a Graves procedure and another a Falls procedure for congenital absence of the vagina before coming to the clinic.

## RESULTS BY MODE OF TREATMENT

*McIndoe procedure* Of the 100 patients who were treated surgically for congenital absence of the vagina, 70 underwent McIndoe operations with a Thiersch graft and an myling mold. All but 15 of the 66 patients traced had obtained excellent results. The average time which had elapsed between the operation and the follow up for the group of 100 patients was more than 4 years. One of the patients in whom eventually excellent results were obtained required two split-skin grafts and then a tertiary graft of fetal membrane. Another patient required a regrant after the primary graft sloughed out during an attack of acute exfoliating dermatitis. Six patients had excellent results but there was some tendency to contracture if the mold was left out and they were unmarried or if the patient's husband was overseas in service and there was no intercourse. One patient who previously had undergone a Graves procedure which resulted in a rectovaginal fistula obtained an excellent result after a secondary McIndoe operation.

Ten patients obtained only satisfactory results, but usually this was because the mold was left out after 6 months when the patients were still single or the mold was used only occasionally between intercourse and some shrinkage occurred and also because there was some contracture as a result of the failure of granulations to epithelize. However 7 of this group who were married reported satisfactory sexual relations.

The results in 5 cases were unsatisfactory. In 1 instance the local physician left the mold out to treat granulations in the vault. In another case a rectovaginal fistula developed colostomy was done and later the rectovaginal fistula was repaired but the second attempt at correction by use of the McIndoe operation resulted in failure. One patient required a secondary Baldwin operation because the obturators were not worn long enough.

*Simple reconstruction* Fourteen patients were treated by this method in which the obturator is worn after the creation of an artificial space, but grafting is not done. All have had excellent results.

In 1 of these cases Ferns reconstructed the vagina of a 15 year old girl. The patient men-

struated regularly after treatment. In the cases in which biopsy was performed a month or more after the operation squamous epithelium was growing and in 1 case in which immediate biopsy was done a similar result was found.

*Baldwin procedure* Fourteen patients underwent Baldwin operation in which the ileum was used to create an artificial vagina. Three patients obtained excellent results although one of these patients later needed a repair for prolapse of the bowel and another had undergone a preliminary unsatisfactory attempt at reconstruction by use of the McIndoe method. Five patients obtained satisfactory results but complained of a profuse irritating vaginal discharge which in 1 case required the use of 4 or 5 sanitary napkins a day. Another patient had intestinal obstruction and a fecal fistula 2 years after the operation and 1 reported some vaginal contracture. Four patients died in the hospital of peritonitis or intestinal obstruction. The average length of time between operation and follow up was more than 8 years.

*Other procedures* One patient underwent a Falls procedure which was apparently satisfactory but this patient could not be traced. Another patient underwent blunt dissection of the rectovesical space and the space was packed with iodoform gauze the result was satisfactory when the patient was last heard from 8 years later.

## COMMENT

Reconstruction of an artificial vagina should be attempted only in patients who are married or are contemplating marriage in the very near future or in the occasional case of hematometra, because many of the cases in which the results were unsatisfactory were single women who would not wear the obturator indefinitely and could not have marital relations because of their unmarried status. Also if a patient is unco-operative or has a tendency to be sexually frigid, the reconstruction should not be attempted. The great majority will not require surgical removal of the uterus or its annexa because these are usually atrophic and asymptomatic. Not infrequently these patients have an associated congenital anomaly of the urinary tract which may require surgical interference namely ectopic pelvic kidneys.

which may be injured during intercourse or infected hydronephrotic kidneys lying in the pelvis. Ureterovaginal fistula may result from anomalous insertion of a ureter.

In 14 cases excellent results have been obtained without grafting. This has been possible because of the inherent ability of the newly formed artificial vagina to epithelize itself. However if there is difficulty in controlling bleeding or in elevating the peritoneum or if the vaginal tract cannot be opened up with ease then a graft should be used. When grafts are not used, epithelium probably arises from the lower segment of the vagina and also from buds of epithelium arising from remnants of the muellerian ducts. Ayre took vaginal smears from an artificial vagina where no graft was used and showed the new lining to be reacting in a cyclic manner to ovarian hormones similar to the way the normal vagina reacts. Whitacre and Wang expressed the thought that the connective tissue elements in this region release a growth stimulating factor especially after trauma. Granulations rarely form in a vagina that is not grafted but if they do they are smaller and are at the sites where bleeding occurred during the original dissection. Marshall has stated that the disadvantages of this simple reconstruction procedure are that a large raw granulating surface is present for 2 to 3 months that secondary hemorrhages occur not infrequently that there is local infection which is not serious and that the procedure must be limited to those patients with a rudimentary vaginal pouch. We have not found these stated disadvantages to be of any consequence. The patients are usually unaware of any discomfort after a brief initial period and there have been only occasional instances of oozing of blood from the vaginal tract. This method can be employed just as easily on the patients without a rudimentary vaginal pouch as on those with a rudimentary dimple.

Thiersch grafts produce excellent results if the take is complete and the mold is worn long enough however occasionally one or more areas are devoid of skin and it is usually necessary to regraft them. McIndoe pointed out that the contraction phase of a canal lined by a Thiersch graft lasts 3 to 6 months or longer

and that removal of the mold before this time has elapsed will result in stricture. This principle applies also to those patients who have not had a graft and the continuous presence of the obturator for 6 months or more is essential.

When a Thiersch graft is used over the mold as has been popularized by McIndoe, the results are usually very satisfactory but it is a more difficult procedure. We have found a greater tendency toward formation of granulation tissue and some areas will need re-grafting. This may result in more contractions than when no graft is used. Our series included 70 cases in which the McIndoe procedure was used.

The attempt at reconstruction of an artificial vagina according to the McIndoe principle should not be made if the patient is single and does not intend to be married in the near future or if she is unco-operative, because the mold must be worn for months. Most poor results are due to too early removal of the mold. The lucite mold we use is nonirritating and probably could be worn for years without any deleterious effects. Also the mold should be worn until the perivaginal and perirectal cellulitis has subsided the contractile phase has passed and the entire tract has been epithelized.

When the Baldwin procedure is utilized the mortality is high (28.6 per cent in our series) and the percentage of good results is low. Many of these patients complain bitterly of the vaginal discharge. It is a more difficult operation with greater morbidity and infection. The Schubert rectal transplant method results in a mortality as high as 12 per cent. Also there is danger of infection there is often damage to the sphincter and a considerable portion of the coccyx is removed and frequently an intestinal fistula develops (27).

Operations in which pedicle grafts are used necessitate longer hospitalization and multiple stages they are more difficult of performance than is simple reconstruction and they have a higher morbidity. Also hair may grow on the inverted flaps. If sloughing occurs, the operation cannot be repeated easily and there is undesirable distortion and mutilation of the vulva (11).

ceral metastasis but only spread to the skin was evident. Thus, there are only 4 cases in which proved metastatic lesions definitely occurred in the viscera and only one in which cutaneous spread was noted. Bereston and Ney concluded that the rarity of metastasis may be explained by the low grade of malignancy and by the possibility that some of the reported cases may have been instances of pseudo-epitheliomatous hyperplasia rather than true malignant neoplasia.

Regarding the subject of the development of carcinoma in fistula in ano Ewing and others had quoted Kraske as follows: "There is no satisfactory evidence that cancer develops in tissues altered by hemorrhoids, fistulae or cicatrices. Since this statement was made, there has been much discussion pro and con. Pennington pointed out in 1923 that fistulas had been known to exist for 35 to 46 years without the occurrence of malignant changes. However he remarked that epitheliomas occasionally are found a short distance up the rectum where they are supposed to arise from old fistulous openings and similar foci of chronic disease.

Lockhart Mummery and Dukes agreed that occasionally carcinoma occurs in fistulous tracts and reported 2 cases in which carcinoma arose in the primary opening of a chronic fistula in ano.

Rosser in 1931 reported 7 cases in which carcinoma developed in anal fistulas. One patient had been operated on for a fistula and an adjacent polyp 1 year before and the latter lesion recurred. Another patient had small warty growths of squamous-cell epithelioma at the external opening. In the 5 other cases adenocarcinomatous tissue was found invading the fistulous tracts apparently originating at the primary opening but without tumor formation at this point except in 1 case.

In 1945 David stated that he had seen 5 instances in which carcinoma developed in long-standing fistulous tracts around the rectum. In 1 case the lesion was a basal-cell carcinoma and in the others it was an epithelioma, neither of which is a type that corresponds to what usually is seen in malignant disease of the rectum. The fistulas in 3 of these cases developed in long standing lesions

of lymphogranuloma inguinale involving the rectum.

A rather extensive review of the literature reveals little information on the subject of the occurrence of epitheliomatous changes in chronic empyemic sinuses. Sauerbrach and O'Shaughnessy did not even make any reference to the occurrence of malignant changes in a chronic sinus when they discussed the complications of chronic empyema. Only one reference was found in the literature and this was simply a case report by Schmid who concluded that carcinomatous changes in fistulas in general, form rare complications in chronic, purulent processes. In his particular case, pneumonia with effusion developed in 1916 and this was treated by thoracotomy; malignant changes were noted in the persistent sinus in 1935 and the patient died within several months, in spite of the use of roentgen and radium therapy.

#### MATERIALS AND METHODS

This is a review of all those cases encountered at the Mayo Clinic in which malignant changes had taken place in chronic, cutaneous sinuses and fistulas, particular emphasis being placed on cases of chronic osteomyelitic sinuses in which malignant changes occurred and in which metastasis was a complicating factor. Nine such cases are reported along with 3 cases of fistula in ano and 1 case of empyemic sinus from the pleural space.

Blocks of tissue were obtained from the new growths, the infected bone and the adjacent lymph nodes when they were available. These blocks were placed in bottles of 10 per cent solution of formalin. The soft parts were sectioned by the freezing method and were stained with hematoxylin and eosin. The blocks of bone were first decalcified with 5 per cent solution of nitric acid. The stained sections were examined microscopically in order to determine the grade of malignancy and malignant tissue occurring in chronic osteomyelitic sinuses was examined carefully to rule out the possibility of pseudo-epitheliomatous hyperplasia. The nodes were examined for evidence of metastasis and the sections made of the "inflammatory" bone were examined for evidence of tuberculosis.

## CLINICAL FEATURES

The files of the Mayo Clinic were productive of 9 cases in which malignant changes occurred in osteomyelitic sinuses (0.23 per cent of approximately 4,000 cases) and 3 in which fistula in ano underwent this change (0.1 per cent of 3,000 cases). In addition 1 empyemic sinus was the site of a similar complication (0.07 per cent of 1,500 cases). These 13 cases serve as the basis for the present study. There were 11 men and 2 women. The duration of the inflammatory tract was 48 years as a maximum and 2 years as a minimum with an average of 26.7 years. The lesion was located in the tibia in 6 cases and in the femur, shoulder, hand and pleural space in 1 case each. Three lesions were fistula in ano.

**Signs and symptoms.** Osteomyelitic group.—The presence of a new growth was obvious in the sinus in 7 of the 9 cases and 6 patients had observed a recent increase in foul smelling discharge. In 1 case some bloody drainage developed. In only 3 cases was pain a prominent symptom. Enlarged regional lymph nodes were present at examination in 7 of 9 cases and the nodes became invaded later in 2 instances. There was no evidence of tuberculous involvement of the bone. The serologic reaction for syphilis was positive in 1 case. Roentgenograms were interpreted as revealing chronic osteomyelitis and in 1 case the following notation was added: "There is irregular destruction of bone which could be secondary to contiguous malignancy." A pathologic fracture was noticed in 2 instances.

**Fistula in ano group.**—The chief complaint was persistent drainage. In 1 case the discharge was hemorrhagic and in 1 there was a foul odor. Proctoscopic examination revealed no primary neoplasm in the rectum. In 2 cases an indurated area had been noted 4 and 7 months respectively previously in the tract. Bacteriologic studies in 1 case revealed neither tubercle bacilli nor *Actinomyces*. Flocculation tests gave negative results. The sedimentation rate in 1 case was 59 millimeters in 1 hour (Westergren method). In 1 case two biopsies of deep-lying tissue were necessary before malignant tissue was noted which illustrates the fact that misleading information may be obtained from superficial examination.

**Empyemic group.**—There was only 1 case in this group. Twenty three years previously the patient with empyema underwent resection of the ribs for pleural effusion and foul drainage persisted. Three years before admission dull steady pain had been noticed. Three months prior to admission blood had appeared in the discharge and dyspnea on exertion had developed. Examination of the sputum and of the discharge from the sinus had failed to reveal tubercle bacilli or sulfur granules. The sedimentation rate was 83 millimeters, the leucocyte count was 8,500 per cubic millimeter of blood, the erythrocyte count was 4,200,000 per cubic millimeter and the hemoglobin measured 14 grams per 100 cubic centimeters of blood. Roentgenograms of the thorax had revealed only thickened pleura.

## PATHOLOGIC FEATURES

**Osteomyelitic group.**—In 2 of the 9 cases (22.2 per cent) metastasis to the regional lymph nodes occurred as a complication.

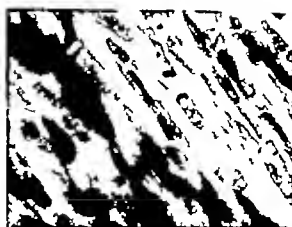
In all of the 5 sections of bone available for study evidence of nonspecific inflammation was found.

All the lesions were characteristic of squamous cell epithelioma and for the most part were of a low grade (Broders' method). 3 were graded 1, 5 were graded 2 and 1 was graded 3. Of the 2 lesions which metastasized 1 was graded 2 and the other was graded 3.

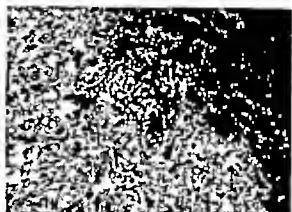
One lesion was originally reported as a grade 3 epithelioma and fibrosarcoma but a review of other sections revealed that it was actually an epithelioma simulating a fibrosarcoma (Fig. 1). This is not a new concept because it has been observed in so called sarcoma of the thyroid and in oat cell tumor of the lung.

In 1 case the biopsy was reported as revealing epithelial hyperplasia and the lesion was excised locally but in less than a year it had recurred and specimens from the amputated leg were characteristic of grade 1 epithelioma.

**CASE 1.** A 57 year old man had had a draining sinus in the upper third of the right tibia for 48 years and 1 year before admission he had noted a small nodule at the side of the tract. Only a biopsy was done which revealed much keratin and some epithelial pearls. In addition there were pale cells with hyperchromatic nuclei and mitotic figures were



b



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Fig. Grade 3 squamous cell epithelioma simulating fibrosarcoma. This lesion occurred in chronic osteomyelitic focus in the right foot. a,  $\times 95$ . b, Note mitotic figures ( $\times 500$ ). c, Metastatic lesion in inguinal lymph node ( $\times 35$ ).

quite rare. The lesion was interpreted as a low grade 3 squamous cell epithelioma but the patient left without undergoing further surgical procedures.

**CASE 2.** A 61 year old man had had a chronic draining sinus in the right medial malleolus resulting from osteomyelitis at the age of 14 years. For a year before admission there had been increased swelling and pain. A cauliflower-like mass measuring 10 by 7 by 1.6 centimeters was present. Microscopically epithelial hyperplasia was present and there were occasional mitotic figures which were definitely some distance superficial to the basement membrane. Both epithelial pearls and intercellular bridges were present. Many plasma cells and fibroblast were observed. The lesion was classified as a grade 3 epithelioma.

**CASE 3.** A 50 year old man had had a draining sinus in the lower part of the right leg for 15 years. Four months before admission he had observed some little growths at the site of ulceration, and on examination at the clinic a cauliflower-like growth measuring 11 by 8 by 0.5 centimeters was noted. Microscopically no pearls were seen but there were cords and clumps of pale-staining squamous cells that penetrated irregularly into the surrounding tis-

sue. Nuclei were hyperchromatic and of variable size. The lesion was classified as a grade 3 epithelioma.

**CASE 4.** A 45 year old man had had the first symptoms of osteomyelitis of the lower part of the right femur at the age of 8 years. At age 35 there were pain and swelling in the right hip and pus was aspirated since then there had been continuous purulent drainage. On examination a mass around the ostium of the sinus at the upper posterior aspect of the right thigh measuring 6 by 5 by 3 centimeters was observed. Microscopically the squamous epithelial cells were large, and hyperchromatic and occasional mitotic figures were seen. Only minimal pearl formation was noted. Many polymorphonuclear leucocytes, fibroblasts, erythrocytes, and plasma cells were present. The lesion was graded 2.

**CASE 5.** A 57 year old man had had a draining sinus in the right leg for 33 years. Four years before the first admission a sequestrum had been excised. In October 1912 examination revealed a granulating mass 3 by 3 centimeters and biopsy of superficial tissue disclosed what was reported as epithelial hyperplasia; however the excised specimen removed at operation contained numerous epithelial pearls

and some pearls were observed in a nearby lymph follicle. Occasional mitotic figures were seen. On July 24, 1912, an amputation was performed at the juncture of the lower and middle thirds of the right femur. The papillomatous lesion extended 1.5 centimeters above the surface of the skin. It was 10 centimeters long by 2 centimeters wide. Microscopically, numerous cords and strands of squamous cells in which there were occasional mitotic figures were observed. Pearls were numerous, and often there was peripheral palisading of the epithelial cells. The lesion appeared to be a grade 1 epidermoid carcinoma.

This case illustrates the misleading information which may be obtained from a biopsy of superficial tissue.

The following case is of interest because carcinoma of the sinus was complicated by the occurrence of metastasis.

**CASE 6.** In 1917 the patient had received an extensive crushing and burn injury to the right hand. Since then the skin had broken down and had healed on numerous occasions. In March 1938 the hand was explored and a keloid was excised from the dorsum. In November 1938 roentgenograms revealed osteomyelitis of the metacarpals of the right hand and at that time some sequestra were removed. Since then there had been constant drainage. When the patient was first seen at the clinic in March 1939, examination of the dorsum of the right hand revealed an ulcer 3 inches (7.6 cm.) in circumference with dirty necrotic bone in its base. At that time the third, fourth and fifth fingers and the corresponding metacarpals were amputated. Microscopically pearls were present as were pale cells with pathologic mitotic figures. Some of the cells contained vacuoles which gave them a pagetoid appearance. There was invasion of bone and many polymorphonuclear leukocytes, giant cells, plasma cells and mast cells were seen. This lesion was classified as a grade 2 epithelioma. The patient was admitted for the second time on April 22, 1942, because of considerable pain in the right axilla. Physical examination revealed a mass the size of an egg in the axilla and this was incompletely excised because of the extensive invasion. Microscopically the regional lymph nodes showed polygonal cells with pale cytoplasm and large hyperchromatic nuclei (Fig. 2). Very few mitotic figures were seen and fibrous tissue had replaced most of the lymphoid elements. The lesion was interpreted as a grade 2 epithelioma.

**CASE 7.** A 58 year old woman had had drainage, off and on, from a sinus located at the lower third of the right tibia for 48 years. Three months before admission a "painless knot" began to grow above the right ankle. On examination the right leg exhibited a healed, scarred sinus on the middle of the anterior surface. Over the anterior surface of the lower third there was a cauliflower like mass measuring 7 by 5 by 2.5 centimeters. Microscopically there were

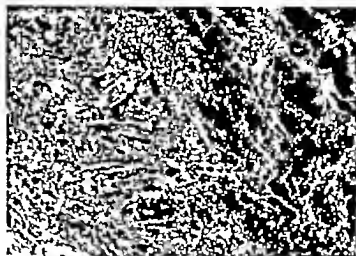


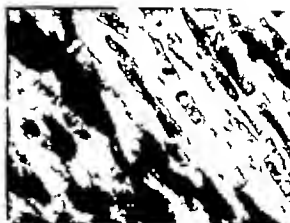
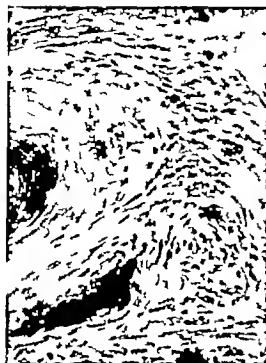
Fig. 2. Axillary lymph node metastasis showing grade 2 squamous cell epithelioma. Primary was grade 2 squamous cell epithelioma developing in chronic osteomyelitis of the right hand (X90).

huge epithelial pearls—many containing cells with intercellular bridges. Peripheral palisading was prominent and in addition there were cords, plugs and strands of epithelial cells. The lesion was considered to be a grade 1 squamous cell epithelioma.

**CASE 8.** A 47 year old man had undergone a left glenohumeral disarticulation at the age of 17 years after his arm had been caught in a machine. Three years before admission the scar over the amputation site had broken down, discharging clear serum that gradually became purulent and foul-smelling. For 7 months a reddish growth measuring 6 by 4 by 1 centimeter had been noted. Excision of the growth, the remaining portion of the scapula and a portion of clavicle was carried out. Microscopically, mitotic figures were noted in the pale epithelial cells which were arranged in typical pearl formation. The lesion was interpreted as a grade 2 epithelioma.

**CASE 9.** A 37 year old man had had osteomyelitis with drainage for 23 years. On April 10, 1933, when he reported to the clinic, he stated that since the last visit in 1927 the painful leg had improved but the sinus continued to drain. Two months before admission soreness developed in the ankle and 10 days before hemorrhage occurred from the sinus. On August 22, 1933, the right leg was amputated at the juncture of middle and upper thirds. Four months later an inguinal lymph node was excised. The specimen consisted of the right foot, the lower two thirds of the leg and an excised lymph node. A sinus was located just superior to the medial malleolus and this led down into the marrow of the tibia where there was a cavity which measured 7 by 6 centimeters and the wall of which consisted of firm rubbery tissue 3 centimeters in thickness. Certain sections showed many large squamous cells with hyperchromatic nuclei and numerous mitotic figures and an occasional well developed epithelial pearl was seen (Fig. 3a). Other sections showed large spindle cells with pale cytoplasm and pathologic mitotic figures (Fig. 3b). Many polymorphonuclear leucocytes and





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**CASE 3.** A 50 year old man had had a draining sinus in the lower part of the right leg for 10 years. Four months before admission he had observed some little growths at the site of ulceration and on examination at the clinic a cauliflower-like growth measuring 12 by 8 by 0.5 centimeters was noted. Microscopically no pearls were seen but there were cords and clumps of pale-staining squamous cells that penetrated irregularly into the surrounding th-

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One patient underwent excision and cautery in September 1921 and died in July 1922. The cause of death was not stated. Radium therapy was apparently without benefit.

Another patient underwent excision of soft tissue and bone from the site of a disarticulation of the left humerus that had been performed 40 years earlier. The patient was given roentgen therapy and 4 years later had had no recurrence.

Two patients underwent excision and curettement one or more times and eventually required amputation. They are both well 4 and 13 years respectively after amputation.

In 1 case (Case 1) in which only a biopsy was done operation was not performed at the clinic. However a letter was sent immediately to the patient's family physician advising that the extremity be amputated because of the malignant nature of the lesion. We have been unable to trace this patient.

**Fistula in ano group** In Case 10 the cavity of the anal fistulous tract was simply curetted and then packed with iodoform gauze. This was done on February 15 1922 and on October 21 1923 the patient died of carcinoma totis.

In Case 11 the entire right ischio-rectal fossa was laid bare and the right wall of the rectum was exposed for about 3 inches (7.5 cm). Between March 12 and March 20 1931 2 343 milligram hours of radium were applied to the region of the sinus and from March 14 through March 18 1931 4 200 milligram hours of radium were given to the left groin and 4 186 milligram hours administered to the right groin. From June 12 to June 13 1931 4 200 milligram hours were applied again to the right groin. At biopsy on September 11 1931 tissue from the right ischio-rectal fossa proved to be malignant. Consequently treatment of the lesion with radon needles was carried out as follows: September 12 1931 480 milligram hours; December 11 1931 782 milligram hours; and March 24 1932 336 milligram hours. The patient died on April 12 1941 from carcinoma of the rectum according to his family physician.

In Case 12 left loop colostomy was performed after biopsy of deep tissues revealed colloid adenocarcinoma grade 1 on October



Fig. 4. Grade 2 squamous cell epithelioma occurring in a chronic empyemic sinus (X65).

12 1943. At that time no involvement of the lymph nodes was observed. On November 2 1943 diathermy was used to remove all the perirectal skin over the growth and the growth itself plus the distal 4 to 5 inches (10 to 12 cm) of the rectum. The patient had received 8 weekly roentgen ray treatments elsewhere preoperatively but the amount was not stated. Postoperatively no more radiation was given. Correspondence on July 15 1946 indicated that the patient was living and well and had had no recurrence.

**Empyemic group** The malignant empyemic sinus was treated by radical excision after the removal of two ribs. However it was felt that not all of the neoplastic tissue was excised. When the patient left the hospital 2 weeks after operation he was complaining bitterly of pleural pain and required frequent doses of opiates. He was not heard from subsequently.

#### COMMENT AND SUMMARY

It has been thought that Cohnheim's theory of chronic irritation accounted for the malignant change occurring in these tracts. However we feel that too much emphasis has been



Fig. 3 Malignant changes occurring in chronic fistula in ano. Section showing grade 3 squamous cell epithelioma.



Fig. 4 Malignant changes occurring in chronic fistula in ano. Section showing grade 1 mucous adenocarcinoma (X355).

plasma cells and an occasional foreign body giant cell were noted. Microscopic section of the lymph node showed numerous large pale epithelial cells with hyperchromatic nuclei. Mitotic figures were numerous (Fig. 1e).

Both the primary and metastatic lesions were interpreted as grade 3 squamous cell epithelioma simulating fibrosarcoma.

**Fistula in ano group**—Of the malignant lesions developing in a fistula 1 was a squamous cell epithelioma and 2 were adenocarcinomas. All 3 were grade 1 lesions. No sinus was identified and the rectal mucosa was normal in each case.

**CASE 10**—A 49 year old man had had a persistent draining fistula for 22 years. The anal canal and rectum appeared normal. Examination of the tissue obtained by curettage revealed cords and strands of squamous malignant cells with no pearls (Fig. 3a). Plasma cells and polymorphonuclear leucocytes were numerous. Apocrine glands were noted in the deep tissues. This was classified as a grade 1 squamous cell epithelioma.

**CASE 11**—Eighteen years before the patient was admitted to the clinic an ischioanal abscess was incised and it continued to drain until 4 years before admission when the fistula healed but occasionally a small amount of pus appeared from the rectum. Four months before admission pain was noted and a tumor appeared. Microscopic examination of tissue obtained when the right ischioanal fossa was laid bare showed definite acinar formation and there were well differentiated columnar epithelial cells. Plasma cells were numerous but no mucus was visible. The lesion was a grade 1 adenocarcinoma.

**CASE 12**—A 58 year old man had had a fistula for 6 years with persistent drainage and 6 months before admission a honeycomb region of draining al-

nuses had appeared. The site of tumor formation measured 6 by 8 centimeters. The growths plus the distal 4 or 5 inches (10 to 12 cm.) of the rectum were resected. Microscopic examination of the tissue disclosed well formed acini containing much mucus, and the lesion was considered to be grade 1 adenocarcinoma (Fig. 3b). The lymph nodes were the site of inflammatory changes.

**Empyemic group**—There was only 1 case in this group.

**CASE 13**—A 55 year old man was seen in February 1945 on account of a chronic empyemic sinus which had been draining since 1918 and had followed thoracotomy for a pleural effusion. Three months before admission, blood began to appear in the foul smelling discharge. Microscopic examination of the excised tract and thickened pleura disclosed much hemorrhage and many lymphocytes and there were numerous cords and plugs of epithelial cells. Pearls and intercellular bridges were present and there was a tendency toward peripheral palisading. Occasional mitotic figures were seen. The lesion was a grade 2 epithelioma (Fig. 4).

#### TREATMENT AND RESULTS

**Osteomyelitic group**—Three patients were treated by amputation and 1 of these had postoperative therapy with roentgen rays. One of these 3 patients lived 11 years and died from gastric carcinoma, another was alive 21 years postoperatively and the third died from chronic nephritis 14 years after amputation.

One patient underwent partial amputation in March 1939, and in April 1942 metastatic lesions were observed in the axillary nodes. Death occurred in July 1947.

One patient underwent excision and cautery in September 1921 and died in July 1922. The cause of death was not stated. Radium therapy was apparently without benefit.

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Fig. 4. Grade 2 squamous cell epithelioma occurring in a chronic empyemic sinus ( $\times 65$ ).

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#### COMMENT AND SUMMARY

It has been thought that Cohnheim's theory of chronic irritation accounted for the malignant change occurring in these tracts. However we feel that too much emphasis has been

placed on the factor of chronic irritation and the basis for our attitude is the occurrence of a low incidence of malignant change in our series—0.23 per cent in the cases of osteomyelitis, 0.1 per cent in the cases of fistula in ano and 0.07 per cent in the cases of chronic empyema. Millgram observed a patient with osteomyelitis for 62 years without finding any evidence of neoplastic change and Pennington reported that DePage had occasion to treat a benign fistula in ano that had existed for 38 years. Rokltansky examined the third specimen of squamous cell epithelioma developing in an osteomyelitic tract (Ditttrich's case) and observed that epithelial cells were growing down the sinus deep into the cavity of the bone. Cone, Schindler, Kaufmann and Brunschwig agreed that there is not much dispute that epitheliomas form from preformed epithelium and that a fistula from a diseased bone which has become epithelized may undergo malignant change.

White and Weidman stated that mitotic figures are seen in simple inflammation and regeneration and that the diagnosis of carcinoma in chronic ulcers is unjustifiable except when infiltration extends to the level of the sweat glands or farther. Consequently they stated that many of the so called carcinomas that develop in a sinus of chronic osteomyelitis are not really malignant but are examples of pseudoepitheliomatous hyperplasia and consequently the incidence of metastasis in such cases is low. However Broders concluded that the day has passed when epithelium can be considered noncancerous, or at most only precancerous because it is within the confines of the basement membrane and conversely it is not carcinomatous simply because it has penetrated the basement membrane. The character of the individual cell is the important factor.

Again it must be emphasized that the two conditions, namely hyperplasia and neoplasia, may coexist. The biopsy in Case 5 revealed epithelial hyperplasia but examination of blocks from the excised specimen revealed epithelial pearls with occasional mitotic figures. Nine months later the sinus had persisted and another irregular raised tumor measuring 10 by 3 by 1.5 centimeters had appeared, sections

of which showed cords and strands of squamous cells with occasional mitotic figures. The presence of pearls and intercellular bridges was noted and in addition there was a tendency to peripheral palisading. At that time amputation of the patient's right leg was carried out. Also in Case 12 the first biopsy was reported as disclosing epithelial hyperplasia with keratosis but microscopic examination of sections from the excised specimen revealed well formed acini with much mucus, and the lesion was diagnosed grade 1 adenocarcinoma. It is granted that epithelial hyperplasia occurring in a chronic osteomyelitic sinus may be misinterpreted as a manifestation of epithelioma with the result that a needless amputation may be performed. However we think that when the biopsy of tissue from a chronic draining sinus or fistula discloses epithelial hyperplasia a wider excision of the sinus should be performed and blocks should be studied carefully for evidence of malignant changes.

Hellner, Benedict and Niebauer pointed out the roentgenologic findings which would make one suspect that malignant changes are taking place around osteomyelitic cavities. This change consists of areas of rarefaction observed in the bone surrounding the cavities. Such a change occurred in our Case 9 (Fig. 5).

Devars in his review stated that of the 39 cases of osteomyelitis in which malignant changes occurred, metastasis to the lymph nodes was noted in 50 per cent and the prognosis was especially grave. No photomicrographs were presented as evidence of metastasis. In the 12 cases reported by Benedict no metastasis was observed and he concluded that the prognosis was favorable owing to the fact that the neoplasm grew slowly and usually was of a low order of malignancy. Up to the year 1941 there were only 7 cases of epithelioma occurring in an osteomyelitic sinus in which proved metastasis occurred and Berenson and Ney added 2 more cases to the literature. In our series of 9 cases of osteomyelitis in which carcinoma developed metastasis occurred in 2 cases (22.2 per cent). One of these patients was living 13 years after amputation of a leg.

In 6 of our 9 cases (66.7 per cent) there were enlarged lymph nodes at the time of operation.

In none of these was biopsy performed but 1 patient died a year later. Two of the 3 patients without palpable nodes eventually had metastasis to the nodes proved by biopsy. Accordingly we propose that even in the face of negative results on biopsy, roentgen ray treatment should be given over the regional nodes and even a prophylactic dissection of these nodes might be considered.

The neoplasms which occur in chronic fistula in ano may be of a squamous cell or basal cell type or glandular in structure. Usually those arising near the anus are adenocarcinomas but owing to the presence of both squamous and columnar epithelium at the dentate line the growth may be of an epitheliomatous nature also. This view is strongly advocated by Rosser (23). Hermann as well as Tucker and Helliwig have demonstrated well developed tubular structures which run from the crypts of Morgagni into the submucosa and sometimes into the internal sphincter. In 1945 Kratzer stated that these ducts could provide a pathway for infecting organisms to penetrate the muscle surrounding the anal canal and thus could produce abscesses with subsequent fistulas.

We examined 5 normal anal rings from specimens removed in combined abdominoperineal resection and demonstrated the presence of erratic glands in the depths of the crypts. We agree with Kratzer that when there is cryptitis these glands may provide a pathway for infecting organisms to penetrate the sphincter as a result of which an ischioanal abscess and subsequent fistula may develop. Also we agree with Rosser (23) that malignant changes may occur in either of the two types of epithelium present as adenocarcinoma occurred in 2 squamous cell epithelioma in 1 of our cases.

The epithelium which became malignant in our case of chronic empyema probably was derived from an inward growth of the surface epithelium just as the surface epithelium grows down to line the chronic osteomyelitic sinus. Since there is no good reason to support the idea that the pleural endothelium may undergo metaplasia we subscribe to the theory that epithelium came from epithelium in this case because at operation the old sinus was observed to be completely epithelialized.



Fig. 5. Grade 3 squamous cell epithelioma invading an osteomyelitic cavity. This demonstrates the small areas of rarefaction in sclerotic bone surrounding the cavities which Helliwig said suggest malignant invasion.

#### CONCLUSIONS

1. Malignant changes in a chronic osteomyelitic sinus should be suspected when a growth appears in the sinus, the discharge becomes more foul smelling or hemorrhagic, a painful swelling appears and when the roentgenogram reveals a pathologic fracture or areas of rarefaction surrounding the osteomyelitic cavity. There were 9 such cases in our series.

2. In our series there were 2 cases in which metastasis occurred from a malignant lesion in a chronic osteomyelitic sinus; these added to the 9 cases reported in the literature make 11 cases in which distant spread occurred.

3. It is proposed that the regional lymph nodes be treated with roentgen rays and that even a prophylactic dissection of these nodes be considered.

4. The transitional epithelium from the erratic glands of the anal crypts probably in



vades the fistula in ano tracts and this may account for the fact that acini are located in some of the fistulous tracts which have shown malignant change. Three such cases are presented in our series.

5 Malignant disease occurring in a chronic empyemic sinus is a surgical rarity. There was 1 case in our series.

6 When the biopsy reveals epithelial hyperplasia the sinus or fistula should be excised and blocks studied for evidence of malignant changes. If neoplastic tissue is found amputation should be done in cases of osteomyelitis and rather radical excision should be done for fistula in ano and empyemic sinuses.

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# THE EFFECT OF INTRAVENOUS GLUCOSE AND AMINO ACIDS ON GLYCOSURIA AND URINARY OUTPUT IN HUMANS

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THE proper rate at which intravenous solutions of glucose should be injected without producing glycosuria and an unwanted diuresis is of obvious clinical importance. This was studied in normal adult individuals given single 1 liter intravenous injections of various glucose solutions under standard conditions but at varying controlled rates. The findings reveal that a slower rate of administration than is ordinarily used should be employed if these undesirable factors are to be eliminated. In addition the experiments indicate that amino acids either as such or as hydrolyzed protein when given in combination with glucose solutions tend to increase the rate of utilization of glucose. This effect was evidenced by the lessened degrees of glycosuria and the lower blood sugar curves which were observed when glucose was administered simultaneously with amino acid solutions than when glucose alone was given at the same rates.

Since 1900 various workers have sought to determine the rate of utilization of glucose in humans and experimental animals in both normal and abnormal states. It has long been recognized that an accurate glucose tolerance can be determined only by introducing the glucose directly into the blood stream, thereby eliminating the variable factors of absorption from the alimentary tract. In 1905 Blumenthal first studied the utilization of glucose by the tissues after intravenous injection. Using normal rabbits he injected varying single doses at 15 minute intervals and observed a retention between 0.15 and 0.32 gram

glucose per kilogram body weight every 15 minutes (0.6 to 1.2 gm per kgm per hour) without glycosuria. Using the same intermittent injection methods, Comessatti in 1906 demonstrated that the rate of utilization was slightly increased in rabbits during and after exercise.

Continuous intravenous injection was first introduced by Woodyatt Sansum and Wilder in 1915 in order to arrive at more accurate figures than could be obtained by the intermittent method. They administered solutions of 18 per cent glucose to normal dogs, rabbits, and adult humans (4 laboratory workers) continuously over periods up to 4 hours in humans 12 hours in dogs using a motor-driven pump to aid in regulating different injection rates. On the basis of their observations they stated that glycosuria consistently appeared at injection rates above 0.9 gram glucose per kilogram body weight per hour, and did not appear at rates below 0.8 gram per kilogram per hour. No species or sex differences were observed. On the basis of this report the figure 0.85 gram per kilogram per hour has been looked upon as being the normal rate of utilization of glucose during intravenous injection in humans and has remained without further experimental verification for 32 years. Sansum and Wilder reported observations in 1917 on glucose utilization in abnormal states. They stated that glucose tolerance was decreased in patients with hyperthyroidism, chronic pancreatitis, mild diabetes, acromegaly, and diabetes insipidus. No lowering of tolerance was seen in patients with alcoholic cirrhosis of the liver.

Postoperative utilization of intravenous glucose was studied by Fantus in 1936. In a series of patients receiving over 200 grams of glucose per day glycosuria was observed in

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TABLE I.—EFFECT OF AMINO ACIDS ON GLYCOSURIA FOLLOWING INTRAVENOUS GLUCOSE

Solution	Rate of Injection	N. Injections	No. patients showing glycosuria
Glucose alone	Less than 1 gm./kgm./hr.	6	
Glucose and amino acids		6	
Glucose alone	More than 1 gm./kgm./hr.	66	69*
Glucose and amino acids		24	†

\*Range of glycosuria, 0 to 6 grams

†Range of glycosuria, trace to 30 grams

over half of the subjects. The rate of injection of the glucose solutions, however, was not regulated. In 1938 Winslow reported another study of glycosuria in postoperative patients who were given intravenous glucose at various controlled rates. This author found a greater tendency for glycosuria to appear during the first 5 days after operation than at any other time and at slower rates of administration than had been observed by Wood yatt in normal animals and humans. For example when 10 per cent glucose was injected at rates of .4 to 8 gram per kilogram per hour during these postoperative days glycosuria would appear in amounts up to 5 per cent of the glucose given. When 5 per cent glucose was used glycosuria was seen to occur in rates as low as 0.35 gram per kilogram per hour however even when a total of 150 grams was administered at this rate usually less than 2.5 grams would be lost through glycosuria.

#### MATERIALS AND METHODS

One hundred and four times and controlled 1 liter injections of glucose solutions were given intravenously to 32 selected adult humans. These subjects were patients in the general surgical wards of the two hospitals they were considered normal in that all were either awaiting plastic or other elective procedures, and consented to postpone their day of operation in order to take part in this study or they had had their operation at least 8 to 10 days previously and were ambulatory and about to be discharged from the hospital. All subjects exhibited normal urinalyses, normal blood glucose and nonprotein nitrogen levels and were in a normal state of nutrition on

regular diets. Their average weight was 69 kilograms. Each subject was weighed the evening before the experiment and the rate of administration of glucose was calculated upon this basis. The glucose solutions employed were those commonly used in hospital wards, and were administered intravenously in the usual amount (1 liter) at various rates, ranging from 0.35 to 3.1 grams per kilogram per hour. The presence and degree of glycosuria resulting from each injection and the degree of associated diuresis were measured in each case. The following solutions were utilized (1) 5 per cent glucose in water (2) 5 per cent glucose in isotonic saline (3) 10 per cent glucose in water (4) 10 per cent glucose in isotonic saline (5) 5 per cent amigen in 5 per cent glucose (6) 5 per cent amigen in 10 per cent glucose (7) 5 per cent pure amino acids in 5 per cent glucose (8) 15 per cent glucose in water (9) 15 per cent glucose in 5 per cent amigen (10) 15 per cent glucose in 5 per cent pure amino acids (11) isotonic saline solution. Nothing was given orally after the midnight prior to the morning's infusion. The patient voided completely or was catheterized just prior to beginning the intravenous injection. All urine was then saved during the next 4 hour period including the time consumed by the intravenous infusion. At the end of the 4 hour period the subject voided completely or was catheterized. Each subject was kept supine in bed the infusion was set and kept at a steady rate by means of an ordinary intravenous administration set with a screw clamp and was watched during the entire period of administration to insure its constant unchanging rate of drip. No food or drink was allowed during the 4 hour period. For the first 30 injections 24 hour urine specimens were also saved and examined but in no case was glucose found to be excreted after 4 hours, so only 4 hour specimens were examined thereafter. The amount of glucose excreted was determined by the quantitative urinary glucose method of Somogyi. Traces less than 0.1 per cent were noted by Benedict's qualitative test.

#### RESULTS

The relation between glycosuria and the rate of injection of glucose is shown in the next

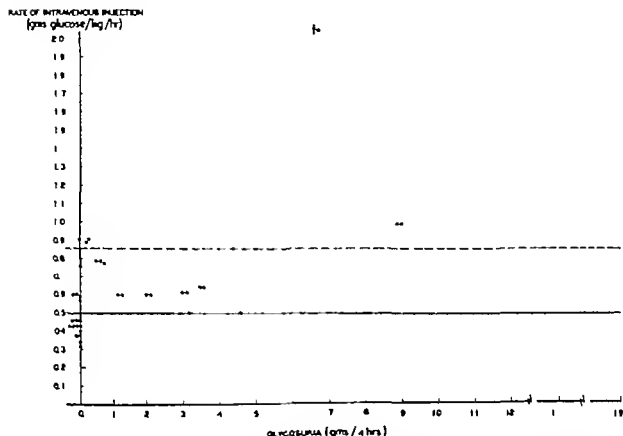


Fig 1 Glycosuria following intravenous glucose. Each point represents 1 experiment. The horizontal broken line represents the rate set by Woodyatt before which glycosuria occurred. Note only at a rate much lower than this (solid horizontal line) did glycosuria occur in these observations (with 1 exception). Note also a tendency for an increase in the amount of glycosuria with increasing rates of injection.

ter graph in Figure 1. From this it will be seen that when glucose was injected at rates less than 0.5 gram per kilogram per hour no glycosuria was produced except in 1 instance whereas at the rates of 0.5 gram per kilogram per hour and above, glycosuria appeared in all but 6 cases. The degree of glycosuria varied considerably among patients and also in single patients when different solutions were given at the same rates. However the rate at and above which glycosuria appeared was constant (0.5 gm./kgm./hr.) rather than at the figure 0.85 as might have been expected in normal humans as a result of Woodyatt's observations. The administration of intravenous glucose at the rate of 0.5 gram per kilogram per hour would mean in practical usage giving 1 liter of 5 per cent glucose to an average (70 kgm.) person at a steady rate over a period of 1 hour and 25 minutes. One liter of 10 per cent glucose would require a period of 2 hours and 50 minutes if glycosuria with associated diuretic effect is to be avoided. The

findings also suggest a tendency for the amount of glycosuria to increase along with increasing rates of administration of glucose but as indicated in the figure the variations were too wide to draw any conclusions. The amounts of glucose excreted ranged from 0.5 gram up to 12 to 19 grams in a few instances. In general the losses were quite small ranging from 2 to 6 grams (4 to 12 per cent of the glucose administered), yet they were consistently present and were associated with significant degrees of diuresis.

Total urinary output was measured during the 4 hour period of observation and is shown in Figure 2. The greatest output of urine followed the injection of 5 and 10 per cent glucose in water. The degree of diuresis tended to increase with the amount of glycosuria produced and with the rate of administration but seemed to hold a closer relationship to the type of solution injected. For example the presence of isotonic saline with 5 and 10 per cent glucose decreased greatly the urinary output.

TABLE II—EFFECTS OF INTRAVENOUS SOLUTIONS IN A SINGLE PATIENT

Date	Intravenous solution	No. of injections	Amount of urine (cc.)	Amount of glucose (gms.) excreted
1947				
8-9	5% glucose in salt	6	1020	
8-10	5% glucose in 5% amino acids	6	70	
8-11	5% glucose in 5% amigen	6	6	
8-12	5% glucose in 5% amino acids	6	720	trace
8-13	5% glucose in 5% amigen	6	900	trace
8-14	5% glucose in saline	6	210	
8-15	5% glucose in water		1020	20 g.
8-16	5% glucose in 5% amino acids		1020	6
8-17	5% glucose in 5% amigen		70	20
8-20	Isotonic saline		90	—
8-21	Isotonic saline	1	210	—

When isotonic saline alone was given an actual hydrating effect was noted, some patients passing as little as 250 cubic centimeters of urine in 4 hours as compared to the usual 600 to 800 cubic centimeters excreted when glucose alone or with saline was administered. The low output of urine with saline is also shown in Table II. 3 injections containing saline produced an output of 280, 240 and 280 cubic centimeters whereas the glucose injections produced an output of 720 cubic centimeters or more. A mild diuretic effect was noted with solutions containing both amino acids and glucose.

The influence of amino acids on glycosuria was studied in 30 injections in which glucose with hydrolyzed protein (amigen) or pure amino acids were given. Six injections were given at rates below 0.5 gram per kilogram per hour and in no case did glycosuria appear (Table II). Twenty four injections were given at rates above .5 gram per kilogram per hour (the rate at which glycosuria consistently appeared when glucose alone was given). In 5 of these 24, no glycosuria appeared and the remaining 19 excreted glucose in comparatively small amounts, ranging from traces to a maximum of 3.8 grams. The presence of amino acids either as such or as hydrolyzed protein (amigen) in some manner effectively reduced the degree of glycosuria as compared with glucose alone given at the same rates. The effect is clearly shown in an experiment car-

ried out in a single patient who was first given concentrated glucose solutions (15 per cent) alone and subsequently in combination with amigen and with pure amino acids administered at the same rates, far above the "threshold" level for glycosuria. A striking reduction in degree of glycosuria was noted when either amino acids or amigen was in the solution (Table II).

With the idea of determining more specifically the nature of the influence of amino acids experiments were carried out in several subjects in which the blood glucose levels were measured at half hour intervals during and following the infusion. Higher blood glucose levels were reached when glucose was given alone than when in combination with amino acids. The hyperglycemia paralleled the degree of glycosuria. This fact tends to indicate that the amino acids act by increasing glucose utilization in the tissues rather than by lowering the renal threshold for glucose excretion. At least, it is apparent that the amino acids in some way enhance the removal of glucose from the circulating blood stream. It was also noted that the effect of pure amino acids in producing a lower curve was more pronounced than that of amigen (hydrolyzed protein) which contains polypeptides as well as amino acids (Table II).

#### DISCUSSION

From this study it is apparent that glucose given to normal humans in a single controlled intravenous injection is utilized at a rate considerably less than that which Woodyatt and his associates concluded to be normal 32 years ago. This variation may possibly be explained by noting a difference in the method of administration employed. In the present experiments a single liter of glucose solution was given at a steady unchanging rate from the beginning of the injection to its completion. No unnoticed variation in rate could occur for the infusion was under constant bedside observation during the entire period of administration to prevent any changes which might result from shifting of the needle, moving of the subject's arm, or other mechanical factors. Woodyatt and associates on the other hand began each injection at a rate con-

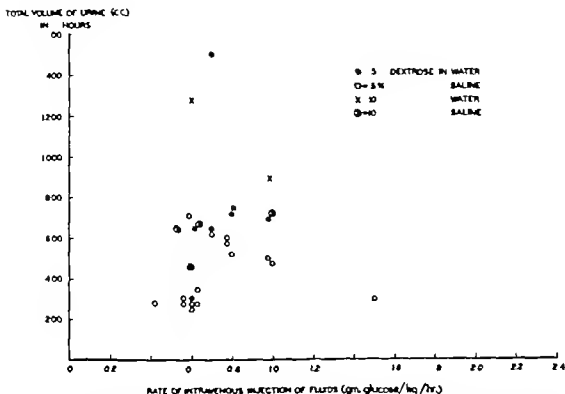


Fig. 2 Urinary output during the intravenous injection of glucose. Each point represents 1 experiment. The effect of saline in reducing urinary output is clearly shown. Note that more than 800 cubic centimeters of urine were excreted only when glucose and water were injected by contrast less than 400 cubic centimeters were excreted in only 3 cases by glucose and water as compared with 9 cases by glucose and saline. See also Table II in which a similar difference was observed.

sidered to be well below that which would produce glycosuria this rate was then increased every half hour until glycosuria appeared. Prolonged continuous injections at constant rates followed this initial stepping up period of administration. It is likely that a lower rate of assimilation would have been observed if Woodyatt had established and maintained a constant lower rate of injection from the beginning especially since our study revealed that glycosuria often did not appear until the second half hour. It is quite conceivable then that Woodyatt and his coworkers might have exceeded the actual rate of utilization and not detected it because of the frequent latency in the appearance of glycosuria.

It is generally believed also that the utilization mechanism is not a static manifestation and that a warming up period is required in order for it to reach its maximum degree of efficiency. Lusk presented the concept that the metabolism of glucose by the tissues tends to increase in the presence of an increased concentration of glucose in the blood stream.

Correspondingly introduction of additional glucose into the blood stream tends to provoke an overproduction of insulin, which then increases the utilization of the subsequent glucose injected. Thus one may bring about a higher rate of utilization by starting infusions at very slow rates and gradually increasing the speed. However the application of such a concept to the clinical usage of intravenous glucose presents certain practical difficulties since fluids ordinarily are given at a more or less constant speed throughout the infusion. The similarity of methods used in this experiment to those in ordinary clinical practice serve to make the findings in this study of practical value.

The hydrating effects of saline in contrast to the diuretic effects of glucose have been observed by Baxter and by Stewart and Rourke who administered massive volumes of intravenous solutions over relatively short periods of time (as much as 5 liters in 4 hours). It is interesting to note that similar effects are evident even in single 1 liter injections.

TABLE II.—EFFECTS OF INTRAVENOUS SOLUTIONS IN A SINGLE PATIENT

Date 1947	Intravenous solution (1,000 cc)	Rate of injection, gm. gluc. /kgm. /hr.	Amount of urine (cc) in 4 hours	Amount of glucose (gm.) excreted
1-9	5% glucose in water	6	1030	—
1-10	5% glucose in 5% amino acids	6	170	—
1-11	5% glucose in 5% amigen	6	8	—
1-12	5% glucose in 5% amino acids	6	730	traces
1-13	5% glucose in 5% amigen	6	900	traces
1-14	5% glucose in saline	6	280	—
1-15	5% glucose in water	—	1030	30 g.
1-16	5% glucose in 5% amino acids	—	1030	8
1-17	5% glucose in 5% amigen	—	1270	30
1-20	Isotonic saline	—	90	—
1-21	Isotonic saline	—	280	—

When isotonic saline alone was given an actual hydrating effect was noted some patients passing as little as 250 cubic centimeters of urine in 4 hours as compared to the usual 600 to 800 cubic centimeters excreted when glucose alone or with saline was administered. The low output of urine with saline is also shown in Table II. 3 injections containing saline produced an output of 280, 240 and 280 cubic centimeters whereas the glucose injections produced an output of 730 cubic centimeters or more. A mild diuretic effect was noted with solutions containing both amino acids and glucose.

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ried out in a single patient who was first given concentrated glucose solutions (15 per cent) alone and subsequently in combination with amigen and with pure amino acids administered at the same rates far above the "threshold" level for glycosuria. A striking reduction in degree of glycosuria was noted when either amino acids or amigen was in the solution (Table II).

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From this study it is apparent that glucose given to normal humans in a single controlled intravenous injection is utilized at a rate considerably less than that which Woodyatt and his associates concluded to be normal 32 years ago. This variation may possibly be explained by noting a difference in the method of administration employed. In the present experiments a single liter of glucose solution was given at a steady unchanging rate from the beginning of the injection to its completion. No unnoticed variation in rate could occur for the infusion was under constant bedside observation during the entire period of administration to prevent any changes which might result from shifting of the needle, moving of the subject's arm or other mechanical factors. Woodyatt and associates, on the other hand, began each injection at a rate con-





The data herein presented also indicate that the presence of amino acids accelerates the utilization of glucose by the tissues. The mechanism by which this occurs is not immediately apparent and further study is being carried out in an effort to determine the exact nature of this effect. At present one can only conclude (in view of the associated lowered blood glucose curves) that the change is specifically in the utilization mechanism and not the result of an altered kidney threshold.

#### SUMMARY

1. With normal adult subjects and commonly employed intravenous glucose solutions given at a uniform rate the maximum speed of injection of glucose without production of glycosuria was found to approximate 0.5 gram per kilogram per hour. This is much lower than the rate of 0.85 gram per kilogram per hour found in normal humans, dogs and rabbits by Woodyatt and his coworkers. In clinical usage this slower rate of injection should be used when intravenous glucose is administered even to patients in a good state of health in order to avoid glycosuria and associated diuresis.

2. Urinary output was considerably reduced when isotonic saline was present in the intravenous solution. Higher concentrations of glucose tended to produce more diuresis than lower concentrations and the amount of diuresis tended to increase with the increased rates of administration.

3. Evidence was obtained that the addition of hydrolyzed protein (amigen) or pure amino acids to the glucose solutions increased the rate of utilization of glucose by the tissues. This was shown by a lower blood sugar level and less glycosuria when amino acids were present than when solutions of glucose alone were given at the same rate.

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# FETAL MORTALITY AND MORBIDITY IN CESAREAN SECTION

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**D**URING the past decade there has been a changing trend in the type of anesthetic agent used for cesarean section at the Royal Victoria Hospital Maternity Division. The following critical survey of fetal mortality and morbidity has been undertaken to compare the results obtained and to study the underlying factors. Cesarean section was performed in 353 cases during the three periods from July 1, 1940 to December 31, 1941, and from July 1, 1944 to July 1, 1945 and from January 1, 1946 to December 31, 1946. These periods were chosen in order to obtain a sufficiently large group of cases of cesarean section carried out under each of the various anesthetic agents. However the number of sections under general anesthesia is still small because those before 1940 were not included. Previous to this time the present facilities for blood transfusion and the newer chemotherapeutic and antibiotic agents were not available. For the purpose of this discussion the infants have been classified as follows: (1) normal those perfectly well at birth who remained so until discharge from hospital; (2) morbid, those who required prolonged resuscitation or had respiratory difficulties as shown by cyanosis and labored respirations during the first 24 to 48 hours but who were apparently perfectly well thereafter; (3) dead nonviable infants still born or those who died shortly after birth.

The data which lend themselves to statistical analysis are presented in the form of contingency tables and have been tested for independence by calculating  $\chi^2$  (3). At the foot of each of these tables is the  $\chi^2$  value, the number of degrees of freedom (n), the probability (1) from Fisher's Table III of  $\chi^2$  and the odds that the observed differences could arise due to chance alone.

In Table I the figures for fetal mortality and morbidity in this series are presented. The term fetal mortality as pointed out by Irving has been used to mean gross fetal mortality which consists of (a) nonviable infants still births and neonatal deaths or (b) just still births or (c) stillbirths and neonatal deaths. In the reports from several large American centers summarized by Irving the fetal mortality using the latter definition ranged from 5.2 to 10.8 per cent. In another group reviewed by Acken the rate ranged from 4.4 to 16.14 per cent however he did not define his use of the term fetal mortality. The value of 7.3 per cent for gross fetal mortality or 5.3 per cent for stillbirths and neonatal deaths in this compilation compared favorably.

The causes of fetal mortality are enumerated in Table II. It is apparent that prematurity<sup>1</sup> and atelectasis play a major role in causing fetal death. This is in accord with Kolin's series. The large number of premature births in this group can be partially explained by the fact that the indication for cesarean section has made it necessary for the operation to be performed at varying periods before term.

Table III shows the kind of anesthesia that was used in these cases. Since prematurity in itself is such an important factor in fetal mortality the results have also been computed omitting all premature births. The term general anesthesia refers to the employment of (a) cyclopropane or (b) nitrous oxide and ether. In all of these some premedication was given 1 to 2 hours before operation and consisted of one or a combination of the following: atropine, scopolamine, heroin, morphine, barbiturates. Spinal anesthesia refers to a single injection of 1 per cent pontocaine in conjunction with ephedrine hydrochloride 34 grain.

<sup>1</sup> Prematurity in this series is defined as a child born at birth with a small number of weeks (estimated) in which it would not develop before the period of gestation. These were all included as premature births.

TABLE I.—FETAL MORBIDITY AND MORTALITY FOLLOWING CESAREAN SECTION

No cases		Normal		Morbid		Total dead		Stillbirths and neonatal deaths	
Sec-tions	Fetuses	No	Per cent	No	Per cent	No	Per cent	No	Per cent
25	27	24	88	4	12	26	9.2	20	7.3

subcutaneously 15 minutes before and  $\frac{3}{4}$  grain repeated immediately before the spinal injection. Local anesthesia refers to the use of 1 per cent novocain. From these figures it appears that general anesthesia gives a slightly higher fetal morbidity and local anesthesia a lowered fetal morbidity but a higher mortality. However the differences are not regarded as significant. The anesthetic agent of choice must not only be most favorable to the fetus but also to the mother. In this series there was only 1 maternal death. The patient had a local anesthetic and death was attributed to uterine hemorrhage. It is of interest that in the last 500 patients who had a spinal anesthetic for cesarean section at the Royal Victoria Maternity Hospital there was only 1 maternal death (6).

The results for full term stillbirths and neonatal deaths are similar to those of Irving. Our results are listed in parentheses after his for the following types of anesthesia: general 4.4 per cent (1.9 per cent) spinal, 4 per cent (2.2 per cent) local 9.7 per cent (4.1 per cent). Allen and Slocum using cyclopropane in 120 cases reported a fetal mortality of 2.5

TABLE II.—CAUSES OF FETAL MORTALITY

Cause	No	Per cent	No	Per cent
Prematurity alone		8	1	16.6
Prematurity associated with other causes	5	2.8		
Asphyxia alone	3			50.0
Asphyxia associated with other causes	7	17		
Congenital abnormalities	3	1.5		
Deadborn, unascertained		9.8		
Erythroblastosis fetalis		3		
Hemorrhage—cerebral, sub-arachnoid		3		
Aspiration pneumonia		1		

TABLE III.—KIND OF ANESTHESIA IN RELATION TO THE FETAL CONDITION

Anesthetic used for mother	N cases	Fetus					
		Normal		Morbid		Dead	
		Observed	Expected	Observed	Expected	Observed	Expected
Spinal	50	34	85	30	97	3	16.7
General	24	41	44	10	8.3	5	3.9
Local	7	64	60		8.7	0	0
$\chi^2 = 77.51, P < .01$ odds 9							

\*Includes 10 premature births

\*Includes 1 premature birth

\*Includes 1 premature birth

per cent and a morbidity of 16.7 per cent. Torrie reviewed 120 sections done under spinal anesthesia with 1 per cent pontocaine and obtained a fetal mortality of 5.8 per cent.

Table IV records the type of anesthesia in relation to the various indications for cesarean section. It is obvious that the higher number of toxemias and medical indications for section in the local group could account for part of the increased fetal mortality. However there is a higher number of cases with placenta previa in the general group and of Rh incompatibility and elderly primipara in the spinal group to

TABLE IV.—TYPE OF ANESTHESIA IN RELATION TO INDICATION FOR CESAREAN SECTION

Indications for cesarean section	Type of Anesthesia					
	Spinal		General		Local	
	No	Per cent	No	Per cent	No	Per cent
Disproportion	97	43	30	37	3	44.5
Placenta previa		9	7	13	3	11
Ruptured section	40	17.6	9	14.7		16.7
Elderly primipara		17		13		
Ischia		7		9		
Toxemia	7	7		16.6	3	11
Rh incompatibility	6	3				
Uterus—micrometers rupture, prolapse, fibroids	17	7.3	3	9.3	3	8.9
Medical—diabetes, nephritis, cardiac, psychoses	10	4.4		16.6	3	6.9
Retroprecipital hemorrhage	3	1.3		9		
Previous hysterectomy, sacrospina, difficult labor, inversion, elective	3	1.4	2	9.3		8

TABLE V — KIND OF ANESTHESIA IN RELATION TO THE FETAL CONDITION IN CASES OF DISPROPORTION

Anesthetic used for mother	No. cases	Fetus					
		Normal		Morbid		Dead	
		Observed	Expected	Observed	Expected	Observed	Expected
Spinal	96	83	86.3	8	9		
General	20	6	8				
Local	3	20	15.7		3		

$$\chi^2 = 6.7 \text{ D.F.} = 4 \quad P = .2 \text{ odds } 4$$

account for part of their increases. Therefore in an attempt to find a group that would be more strictly comparable the type of anesthesia in relation to the fetal condition has been analyzed in the cases in which disproportion was the only indication for section (Table V). Although fewer cases are considered than in Table III the same general conclusions appear to hold.

In Table VI an attempt is made to evaluate the effect on the fetus of the type of premedication used for the mother. The cases of spinal, general, and local anesthesia in which the fetus did not have the special management described in the following have been included in this study. It would appear that the opiates given to the mother increase fetal mortality; this is probably due to the narcotic effect on the fetus.

TABLE VI — TYPE OF PREMEDICATION USED FOR THE MOTHER IN RELATION TO THE FETAL CONDITION

Premedication used for mother	No. cases	Fetus					
		Normal		Morbid		Dead	
		Observed	Expected	Observed	Expected	Observed	Expected
Morphine or heroin or opiat plus barbiturat	7		9		3.3	3	8
Atropine plus hyoscine or tropine plus barbiturat		43		6	6		4
Barbiturat			8.5				3
Ephedrine	7	10	10.3	4	8.7		
Urethane plus hyoscine or hyoscine	20	6	4		4.9		
No premedication			7		8		

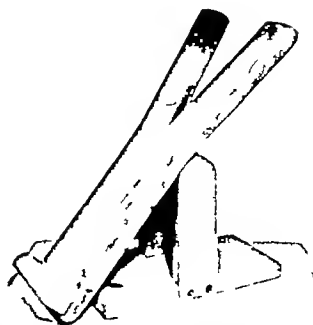


Fig. 1. A tilt table designed to lower the baby's head at any angle when the infant needs resuscitation; the rocker method may be employed to tilt the baby up and down.

and the consequent depression of the respiratory mechanisms. However there is no significant difference between the treatments particularly in view of the fact that a certain bias exists in the indication for the type of premedication.

The high fetal mortality and morbidity rates particularly due to atelectasis in cases of cesarean section prompted the members of the pediatric service in January 1946 to suggest that all these infants be postured with head down perpendicularly for  $\frac{1}{2}$  hour after birth and that at the same time the excess mucus be

TABLE VII — FETAL CONDITION IN RELATION TO USE OF SPECIAL MANAGEMENT OF INFANT IMMEDIATELY AFTER BIRTH

Anesthetic used for mother	Fetus					
	Normal		Morbid		Stillbirth and neonatal deaths	
	Observed	Expected	Observed	Expected	Observed	Expected
Special management used, 7	5		6	9.7	6	6.9
Special management not used, 7	6	50.8	4	1		

$$\chi^2 = 73.1 \quad \text{D.F.} = 1 \text{ odd}$$

Includes 4 perinatal or births  
Includes 4 perinatal or births



Fig. 1. Hand suction apparatus which prevents contamination ordinarily caused by mouth suction. There is an outlet at the end of the rubber bulb.

aspirated from the mouth and pharynx. The latter permits drainage of amniotic fluid and mucus from the respiratory tract and so tends to prevent obstruction by these materials. It was also suggested that oxygen be administered intermittently by mask under positive pressure in an attempt to aid expansion of the fetal lung tissue and to improve oxygenation of the blood. In Table VII two groups similar in all respects except for this special management of the infants are compared. The trend in the data is in favor of this special management but the difference is not significant.

The fetal deaths have been analyzed in relation to the indications for section in the mother and are shown in Table VIII. Fifty per cent occurred in instances in which placenta previa was the reason for section. This emphasizes the importance of hypoxia as a result of maternal blood loss in fetal mortality. The significance of preventing a sudden drop in blood pressure under spinal anesthesia which may impose the deleterious effects of hypoxia in both mother and fetus and the administration of ephedrine to ameliorate this condition is emphasized in Torne's article.

TABLE VIII—FETAL DEATHS IN RELATION TO INDICATION FOR CESAREAN SECTION

Indication for cesarean section	Fetal deaths	
	No.	Per cent
Placenta previa	5	50
Rh incompatibility	1	10
Repeat section	1	10
Toxemia	1	10
Chronic asplenia	1	10
Chronic cardiac	1	10
Disproportion	1	10



Fig. 3. Baby being resuscitated on the tilt table. The baby is placed in the heated cot. Note the legs fastened by means of cotton bandage. The hand suction is also being used to clear the air passages.

While these data have not shown a significant difference between treatments, the consistency of the direction of the trend has prompted us to continue this study and to suggest that in order to reduce fetal mortality and morbidity in cesarean sections general or spinal anesthesia without premedication but with the special management of the infants be utilized. With a general anesthetic when the uterus is opened the maternal respiratory system should be cleared of all anesthetic gases and 100 per cent oxygen be given to prevent hypoxia in the fetus. When spinal is used, particular care should be taken to prevent fluctuation of maternal blood pressure. In cases in which placenta previa is on for section, transfusions should be given to the mother to prevent the fetus from becoming anemic. The oxygenation of the fetus is also important in the operation.

sistent with the particular indication for cesarean section

The following routine is recommended in handling infants delivered by cesarean section

1 Have a pediatrician present to receive the infant from the obstetrician

2 Place the infant in a heated crib and cover with a previously warmed blanket

3 Hold the infant perpendicularly with the head down for 20 to 30 minutes or tie the infant to a tilt table as designed by one of the authors (Fig 1) This is particularly useful when the infant needs resuscitation since the rocker method may be employed by tilting the table up and down Oxygen can be given by mask at the same time

4 Aspirate the mucus and amniotic fluid from the nose mouth and pharynx One may use a rubber catheter with a glass trap However this has the disadvantage that occasionally bacteria from the doctor's upper respiratory passages may reach the infant and vice versa One of the authors has designed a hand suction apparatus (Fig 2) which prevents this difficulty These are used in preference to the various mechanical suction types of apparatus which are connected to the resuscitation machines because we have found the strong suction in the latter can injure the oral and pharyngeal mucous membrane of the infant The frequent application of the catheter to the posterior pharynx may also initiate vomiting If this occurs when the doctor is present he can remove the fluid whereas if it should occur when the infant is alone in its crib some of the vomitus may be aspirated into the lower respiratory tract

5 Administer oxygen intermittently by mask

6 Perform routine care such as the administration of vitamin K intramuscularly and the instillation of silver nitrate solution to the eyes

7 Return all infants to the premature ward for careful observation and tilt the crib to an angle of 45 degrees and place the infant in crib so that the head is at the lower end for a period of 12 hours

#### SUMMARY

1 In 357 infants delivered by cesarean section the gross mortality was 7.3 per cent and the morbidity 11.2 per cent

2 Of the fetal deaths prematurity and atelectasis accounted for 36.6 and 29.3 per cent respectively

3 Fetal mortality in cesarean section was high due to the maternal complications which necessitated the operation Spinal anesthesia has not appreciably affected the fetal mortality but it has definitely lowered maternal morbidity and mortality

4 Disproportion was the principal indication for section

5 Premedication in the form of morphine heroin or ephedrine appeared to have an adverse effect on the fetus but the difference was only slight

6 Special management of the infant at birth tended to reduce the fetal mortality and morbidity

7 Of the fetal deaths, 50 per cent occurred in those cases in which placenta previa was the indication for section

8 A method for handling infants born after cesarean section is described

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# PROLAPSE OF REDUNDANT GASTRIC MUCOSA

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In the past the presence of hypermobile redundant gastric mucosa has been such a common and incidental finding by surgeons and roentgenologists that little significance was placed upon it as an etiological factor. Consequently no attempt was made to correct the condition. Since Scott in a recent article gave impetus to the study of this problem more and more writers are beginning to recognize its significance as a clinical entity and as the cause of many otherwise unexplained gastrointestinal complaints. It is difficult to understand why this condition should have been so universally overlooked in the past in patients with gastrointestinal disease.

Blockus still believes that only severe prolapse associated with gastritis can cause symptoms and then only after producing partial pyloric obstruction. He also feels that gastric symptoms from this source are so rare that they have no practical significance. Others also believe that this lesion is of no particular significance and some roentgenologists do not report this abnormality. On the other hand Melamed (4) has collected 25 cases of prolapse with symptoms all relieved either by medicine or surgery.

During the past year we have observed no less than 22 such patients with symptoms which were otherwise unexplained, 5 of whom came to surgery. All 5 patients operated upon have experienced relief from symptoms and a more detailed analysis will be given later. In 1926 Eliason, Pendergraes and Wright first described the roentgen signs produced by prolapse of gastric mucosa. In Melamed's (7) original article in 1943 he was able to find only 19 proved cases in the literature and published a report of 1 case of his own, a total of 20 cases. On the other hand Archer states that prolapsing gastric mucosa is not rare but he gives

no figures. Feldman indicates that redundant gastric mucosa occurs in approximately 1 per cent of all patients with gastrointestinal tract disease and points out that the condition is not recognized until mucosa prolapses into the pyloric canal or into the duodenal cap. In Scott's survey of this problem 19,228 hospital admissions were analyzed. Roentgenological examinations of the upper gastrointestinal tract were made in 1,346 of these patients which revealed the presence of gastric ulcer in 13 or 0.96 per cent, duodenal ulcer in 325 or 24.1 per cent, duodenitis in 17 or 1.3 per cent, prolapse of redundant gastric mucosa in 14 or an incidence of 1.04 per cent, gastric tumors in none. In our series of patients upon whom an upper gastrointestinal tract examination was made the incidence of prolapse of gastric mucosa was even greater. A review of 650 consecutive examinations revealed that prolapse had occurred in 22 cases, a percentage of 3.38. This corroborated our original impression that the incidence is greater than usually suspected.

In the past prior to the development of our interest in the presence of this lesion this diagnosis was overlooked in many cases because first, the examiner was unaware of the significance of the finding, second filling defects produced by prolapse were confused with those due to other conditions, and third when recognized the condition was believed to be of no clinical importance and an attempt was made to explain the clinical symptoms on some other basis.

## SYMPTOMATOLOGY AND PHYSICAL FINDINGS

Patients with prolapse of redundant gastric mucosa complain of a variety of symptoms which usually are influenced by the extent and the condition of the prolapsed mucosa. These symptoms are never characteristic and do not permit a clinical diagnosis of the disorder. As a general rule the diagnosis must be made on

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the basis of roentgenologic findings after elimination of the presence of all other gastrointestinal lesions. Likewise the objective physical findings are indecisive with the exception of a palpable tumor mass in the epigastrium in the region of the pylorus. Such a mass is characterized by its soft doughy consistency associated with free mobility and with a very characteristic sensation to the examining fingers when the prolapse is reduced. This palpable quality can be likened only to that of a hernia during the process of reduction under the palpating fingers. This sensation no doubt is caused by the sliding of the prolapsed gastric mucosa back through the pyloric ring and its finding on physical examination is pathognomonic of the lesion just as the similar findings of a soft tumor mass in the groin which can be reduced back into the abdominal cavity through a small defect in the abdominal wall with a mucous gurgling sensation is pathognomonic of hernia. In 2 of our patients reported in this series this finding was present on numerous occasions. And in each case immediately after the reduction of the prolapsing mucosa through the pyloric ring by the examining fingers the palpable tumor could no longer be demonstrated.

The only other physical finding of any consequence is the occasional presence of mild tenderness in the region of the pylorus which of course is an incidental finding and may be associated with numerous lesions in this region.

The major symptoms therefore of which these patients complain are intermittent epigastric distress with cramping pains no doubt based on partial pyloric obstruction varying relationship to food sense of fullness bloating and heart burn nausea and vomiting gastrointestinal hemorrhages. The disorder should be suspected in any patient with an atypical ulcer history in whom there is not a satisfactory response to ulcer regimen and in those with repeated recurrences when placed on solid foods as well as in those with recurrent functional complaints and with recurrent small or large gastrointestinal bleeding which cannot be explained on any other basis.

As a general rule the routine laboratory examination of the blood and urine reveals no abnormality. Secondary anemias due to pro-

longed intermittent bleeding may be found in some patients. Scott reports that in over two-thirds of the patients gastric analyses show results within normal limits in one-third hyperchlorhydria is revealed. Persistent occult blood in the stools may be found in many of these patients.

Gastroscopic examination was done on one of our patients and no abnormality discovered. Similarly those who report the findings on gastroscopy do not indicate that any significant evidence may be obtained by this method. However the principal value of gastroscopy in these cases lies in the ruling out of other gastric lesions which may be missed by roentgen examination.

#### DIAGNOSIS BASED ON ROENTGENOGRAPHIC FINDING

The diagnosis of prolapse of the gastric mucosa into the duodenum should be suspected from the clinical history and on occasion from the physical findings. However the appearance at fluoroscopy and on examination of the roentgen films is quite characteristic and the condition is easily recognized by the roentgenologist if the pathology of the disorder and the following features are kept in mind.

Characteristically prolapse of redundant gastric mucosa into the duodenal bulb is represented by a central filling defect near the base of the bulb most often lobulated. This gives a mushroom or cauliflower like appearance which may vary somewhat in extent and configuration on the same and different examinations. In our experience the defect has been more readily demonstrated in the horizontal than the erect position. In most instances the defect is traversed by lines of increased density which can be followed into the stomach and are continuous with the gastric rugae. In uncomplicated cases the outline of the bulb is smooth and fluoroscopically no irritability or spasm is noted. Point tenderness has not been a frequent finding. In several of the cases some narrowing of the pylorus has been noted suggesting hypertrophy. Although seen in a number of the cases hyperperistalsis has not been constantly associated. There were no craters seen, and no patients had gastric





lesion, many factors have been suggested which may contribute to its occurrence. An enumeration of these factors may be set down as follows: first the presence of a small unrecognized mucosal ulcer which results in the hyperplasia of the gastric mucosa (Bralow and Melamed 4); second the presence of hypertrophic gastritis (Boeckus); third persistent hypermotility of the stomach; and fourth congenital variation in the anatomy of the stomach structure consisting of a gastric mucosa which is abnormally hypermobile on the surface of the gastric muscularis.

All of these factors seem to be adequately summarized by Scott who points out that the one common denominator in the theories regarding the etiology of prolapse is an abnormal disturbance of gastric peristalsis and function. The most common continuous and effective means of altering gastric functions springs from the effects of emotions and the nervous system on gastric motility. Consequently in view of the construction of the stomach walls which normally permit some degree of mobility between them it seems possible that certain neurogenic factors are the inciting cause of a disturbed gastric function that ultimately brings about a mucosal prolapse. This fact becomes more possible when one bears in mind that secretory as well as motor activities of the stomach are definitely correlated through Meissner's plexus located in the submucosal coat of the stomach. The pre-existing disease process of the gastric mucosa is not necessary for the production of a prolapse. Melamed is inclined to support this theory and indicates that since the muscularis mucosa is known to have muscular activity independent of that of the main musculature of the stomach it is entirely possible that neurogenic factors are the inciting cause of a disturbed gastric function that ultimately brings about a prolapse. He further points out that it has been repeatedly shown that emotion such as worry, fear, excitement and anger alter not only gastric chemistry but also peristalsis.

In considering the fourth and most important factor in the etiology of the lesion, namely the abnormal hypermobility of the gastric mucosa on its muscularis which may



Fig. 2. Case 2. Large lobulated defect in the bulb, but the contour of the bulb is maintained. Appearance is similar to that of polypoid growth.

be either a congenital characteristic or an acquired lesion. Melamed points out the following facts. In the first place in the normal gastric antrum the mucosa and muscularis are connected by soft yielding submucosa composed of loose areolar tissue containing blood vessels, lymphatics and nerves. This explains a certain amount of limited mobility of the mucosa on the muscularis as is found in all normal stomachs and may be easily demonstrated at autopsy. Scott points out that in his study of over 100 fresh stomachs normally the extent of this movement was not sufficient to permit a prolapse and that in those few cases in which a prolapse could be produced the previous history of the patients indicated that they actually had had gastric symptoms. Melamed was not able to confirm this observation since in several cases which he witnessed the gastric mucosa could be pulled



Fig. 1. Case. Large central defect at the base of the bulb, bulging downward, appearing as the gastric fundus in the defect.

residual at 6 hours. It is well to attempt to classify the degree of prolapse (mild, moderate and marked) as this may be of some clinical value.

**Differential diagnoses.** (1) Prolapsing polypoid tumor of the pyloric end of the stomach. It is possible that at times a definite differentiation cannot be made. The tracing of the rugal fold into the defect, however, should aid considerably in establishing the diagnosis. Also, in prolapse there will be no defect seen at any time on the gastric side of the pylorus. (2) Hypertrophy of the pyloric sphincter. In this condition there is a curved pressure defect on the base of the duodenal bulb, but no area of radiolucency is seen. The umbilical appearance which has been described in the literature has been found to be present in prolapse more frequently than one would expect normally. This is probably due to the fact that in prolapse hypertrophy of the pylorus takes place

(3) Duodenitis. As has been mentioned before, the lack of spasm and irritability of the bulb should establish the differentiation. Likewise, instead of the rugal pattern being enlarged and irregular, it is more apt to be compressed. (4) Duodenal ulcer. In prolapse the margins of the bulb are smooth, even in cases of marked degree. In our present series there have been 2 cases of a associated duodenal ulcer and prolapse of gastric mucosa. In 1 of these a gastric enterostomy was performed 20 years previously for the ulcer. When these two conditions coexist in addition to the central defect, one notes a deformity of the contour of the bulb or a crater. (5) Hypertrophic gastritis. In this condition the enlarged gastric rugae may enter the bulb, but in addition to evidence of disease in other portions of the stomach, each gastroscopy should readily reveal the true nature of the condition. (6) Polyp of the duodenum. These are infrequently found. When present they may be in other places than at the base of the bulb. The gastric rugae will not be traced into the defect.

In the past it is probable that prolapse has masqueraded as one of the above conditions, mainly because we have not been alert and aware of this entity. The roentgenology appearance, however, is sufficiently characteristic to establish the diagnosis.

#### TREATMENT AND RESULTS

Treatment of the vast majority of these patients may satisfactorily be confined to medical measures, and in slight and moderate prolapses frequent small feedings of a bland diet usually afford relief. In some hospitalization, rest in bed and freedom from tension associated with the elimination of all condiments as well as tobacco, alcohol and caffeine will effect some degree of relief from distress. On the other hand, there is little reason for one to assume that such relief will be permanent. Although the etiology of this lesion is not clear, the pathology is definite enough for one to conclude that the lesion is purely on a mechanical basis, and once established will in all probability receive no permanent relief short of mechanical correction. Regarding the etiology and pathology of the

lesion many factors have been suggested which may contribute to its occurrence. An enumeration of these factors may be set down as follows: first the presence of a small unrecognized mucosal ulcer which results in the hyperplasia of the gastric mucosa (Bralow and Melamed 4); second the presence of hypertrophic gastritis (Bockus); third persistent hypermotility of the stomach; and fourth congenital variation in the anatomy of the stomach structure consisting of a gastric mucosa which is abnormally hypermobile on the surface of the gastric muscularis.

All of these factors seem to be adequately summarized by Scott who points out that the one common denominator in the theories regarding the etiology of prolapse is an abnormal disturbance of gastric peristalsis and function. The most common continuous and effective means of altering gastric functions springs from the effects of emotions and the nervous system on gastric motility. Consequently in view of the construction of the stomach walls which normally permit some degree of mobility between them, it seems possible that certain neurogenic factors are the inciting cause of a disturbed gastric function that ultimately brings about a mucosal prolapse. This fact becomes more possible when one bears in mind that secretory as well as motor activities of the stomach are definitely correlated through Meissner's plexus located in the submucosal coat of the stomach. The pre-existing disease process of the gastric mucosa is not necessary for the production of a prolapse. Melamed is inclined to support this theory and indicates that since the muscularis mucosa is known to have muscular activity independent of that of the main musculature of the stomach, it is entirely possible that neurogenic factors are the inciting cause of a disturbed gastric function that ultimately brings about a prolapse. He further points out that it has been repeatedly shown that emotion such as worry, fear, excitement, and anger alter not only gastric chemistry but also peristalsis.

In considering the fourth and most important factor in the etiology of the lesion, namely the abnormal hypermobility of the gastric mucosa on its muscularis which may



Fig. 3. Case 3. Large lobulated defect in the bulb, but the contour of the bulb is maintained. Appearance is similar to that of polypoid growth.

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Fig. 1. Case 1. Large ventral defect in the duodenal bulb. The gastric mucosa is demonstrated passing through the defect.

through the pylorus with a forceps and he intimated that a gastric mucosa could be pulled through to correspond with Scott's description of a small prolapse.

Obviously the lesion then is a mechanical one based on a hypermobility of the gastric mucosa which may be congenital in nature or may have been produced by abnormal gastric motility which over a period of time loosens the attachment of the mucosa to the muscularis to such an extent that a prolapse can occur. In all probability such a lesion cannot correct itself but must be corrected by mechanical means such as removal of the redundant mucosa or adequate anchorage of the mucosa to the muscularis.

This does not preclude that all such patients must be treated surgically since a vast majority of them can live comfortably and without symptoms by simple medical management as previously pointed out. We must therefore consider the logical indications which justify surgical treatment. The essential factors which influence a decision with respect to the advisability of surgery are first the persistence, severity and intractability of symptoms. In other words, if the symptoms



Fig. 2. Case 4. Trephine biopsy defect. Internal view of the bulb. The biopsy site is no longer apparent.

are persistent and intractable to medical management the patient as well as the surgeon will in all probability be inclined to seek more drastic means of relief. The second essential factor is that of pyloric obstruction to the extent that recurrent persistent vomiting may occur which is associated with the failure of the patient to maintain his normal weight. Obviously such a lesion is disabling and interferes with the body physiology to the extent that partial starvation is present. It therefore warrants the risk of surgical intervention for its correction. The third essential factor one we believe important is repeated gross gastrointestinal hemorrhages experienced by an occasional patient or a secondary anemia resulting from repeated small bleeding. Such patients obviously require surgical correction of the lesion since hemorrhage can occur to such a great extent as to endanger life. In 2 of our patients such a problem was present.

## SURGICAL ASPECTS

a Surgical correction of these lesions is usually accomplished by resecting a generous portion of the redundant gastric mucosa following which some type of an adequate pyloroplasty is done. Such a procedure is recommended by Bohrer and Copleman. Rees recommends not only antral gastrotomy with excision of the redundant mucosa and pyloroplasty but also anchorage of the mucosa to the muscularis and section of the pyloric muscle. A similar type of procedure is suggested by Archer and Cooper. Scott and Bralow and Melamed. Recently more radical procedures have been suggested. Norgore, Martin and Schuler reported 2 instances in which they did a Finsterer type of retrocolic enterogastric anastomosis following a partial resection of the stomach. In our patients who came to surgery the procedure has been one of antrotyomy with division of the pyloric muscle resection of an abundant portion of the prolapsing gastric mucosa followed by a Horsley pyloroplasty or Finney pyloroplasty. We have not felt justified in doing the more radical procedure of partial gastric resection.

b *Findings at operation* Upon celiotomy in a case of suspected prolapse of the redundant gastric mucosa it is essential that certain findings be present before one is justified in carrying out an extensive surgical procedure. The following exploratory maneuvers are done before a final decision is arrived at. First, the stomach is adequately exposed and the pylorus and duodenal bulb are gently palpated. In most cases if prolapse is present, a soft doughy mass is distinctly palpable in the duodenal bulb. By gentle taxis this mass is reduced through the pylorus into the stomach and can be reproduced by a gentle milking action on the pyloric end of the stomach. Such a finding is pathognomonic of the lesion. On the other hand if palpation of the stomach reveals a prominent folded gastric mucosa in the pylorus which does not at the time produce an actual prolapsing mass into the duodenal cap, one is justified in doing an antrotyomy. The gastric mucosa is then tested for hypermobility by securing a fold of the mucosa by means of the forceps placed well above the pyloric sphincter. By this means a hyper-

mobile gastric mucosa may be easily pushed through the pyloric sphincter into the duodenal cap and may readily produce a typical prolapse. If this finding is present one is justified in resecting a generous portion of the mucosa which is readily done by raising a large fold of the posterior gastric mucosa between two Allis forceps and applying a clamp at the base of this folded mucosa longitudinal to the axis of the stomach and crossing the pyloric sphincter. The cut edges of the mucosa are then approximated by atraumatic catgut suture which may on occasion include a small portion of the gastric muscularis so that adequate anchorage is effected.

ANALYSIS OF CLINICAL ASPECTS  
IN OUR CASES

Analysis of the clinical aspect in 20 cases (2 ulcer patients excluded) revealed. The average age was 49 years the youngest being 26 the oldest 64. Fourteen were males 6 were females. Twelve were obese 5 were slightly overweight. Eighteen were white 2 negro. History of overindulgence of alcohol was present in 5 cases.

The average duration of symptoms was 2 to 3 years. Abdominal pain or discomfort was the most common complaint. This varied considerably both as to type and location. Pain was relieved by food in 4, aggravated in 8 not related in 5 and indefinite in 3. Seven stated that pain was aggravated by fatty foods spices and alcohol. Vomiting was a prominent symptom in 3 cases fairly frequent in 4. There was a history of more than 3 massive bleeding episodes in 2 cases 3 others gave a history of hematemesis or tarry stools.

RELATION OF SYMPTOMS TO DEGREE OF  
PROLAPSE

There were 6 cases classified as mild prolapse 7 as moderate and 7 as marked. In the patients whose symptoms were controlled poorly by diet 4 had marked prolapse 2 moderate and 1 mild. As to severity of symptoms in the 6 cases classified as mild prolapse, 5 patients had vague complaints in the 7 cases of moderate prolapse 5 patients had both some symptoms 6 of the 7 patients with severe prolapse had severe symptoms. (The remain

ing patient's only complaint was repeated gastrointestinal hemorrhages.)

### CASE HISTORIES

**CASE 1.** F. S., 45 year old white male, complained of pain in the upper abdomen of several years duration. The pain consisted of recurring cramps following meals. Other history was essentially negative. Patient did not respond to a medical regimen. He was operated on and a resection of redundant gastric mucosa associated with Finney type of pyloroplasty was performed. Patient has now been free of complaints for 1 year.

**CASE 2.** C. N., 35 year old female, had repeated attacks of nausea and pain in the upper abdomen of 4 to 5 years duration. In the past few months she had developed nocturnal vomiting. The pain was aggravated by food intake particularly solid foods. There was some weight loss. The patient was operated on a large quantity of redundant gastric mucosa was removed and a Finney type pyloroplasty was performed. Following operation gastric complaints disappeared. The patient has gained weight as a result of her ability to eat any type of food.

**CASE 3.** W. C., 37 year old negro male had a 4 year history of burning pain in the epigastrium occasionally relieved by food occasionally aggravated by food. Gas and sour stomach were also present. Vomiting occurred at infrequent intervals. There was a history of several episodes of frank hematemesis and tarry stools. In the past he had been told he had a duodenal ulcer and had received some benefit from an ulcer diet. Following operation (resection of redundant gastric mucosa and pyloroplasty) the patient had complete relief from symptoms. (Incidentally, no ulcer was found at operation.) Six months later the patient returned with a history of vague abdominal distress for 2 to 3 days followed by hematemesis and tarry stools. Gastrointestinal series at this time revealed a deformed bulb and pylorus which was considered to be secondary to the pyloroplasty. Hemorrhage may have been due to a shallow ulcer at the suture line. The patient treated conservatively has been symptom free for 3 months.

**CASE 4.** D. M., 61 year old white male, has been suffering from generalized rheumatoid arthritis for many years. He had a history of massive hematemesis 6 times in the last 5 years. Numerous previous gastrointestinal studies were said to be negative. There were no other gastrointestinal complaints. The patient was operated on and resection of redundant mucosa and Finney pyloroplasty were performed. It has been only 3 months since operation. The patient states however that he can now recognize that he did have some abdominal distress prior to the operation which is no longer present.

**CASE 5.** T. B., 54 year old female complained of stomach trouble for the past 4 to 5 years. Pain was

present in the upper abdomen aggravated by food intake. No relief was obtained from diet or other medical measures. The patient was operated on, redundant gastric mucosa existed, and a Heineke-Mikulicz pyloroplasty was performed. Since the operation the patient has been entirely free of symptoms.

### CONCLUSIONS

1. Prolapse of gastric mucosa is more common than generally suspected.
2. The diagnosis can only be established roentgenologically since the clinical picture is extremely variable.
3. Mild degrees of prolapse rarely produce symptoms and probably are only an incidental finding.
4. Moderate or marked degrees of prolapse are often associated with complaints of sufficient severity to cause the patient some degree of disability.
5. The most common complication of prolapse is gastrointestinal hemorrhage.
6. The symptoms of prolapse can be controlled medically in the majority of instances.
7. With symptoms of sufficient degree failure of response to medical treatment is an indication for surgical treatment. Surgery is also indicated in those patients who have had repeated severe gastrointestinal hemorrhage.
8. The surgical procedure of choice is the simplest which will correct the lesion—antrotomy with removal of redundant gastric mucosa combined with some type of pyloroplasty.

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# INDURATED LEG AND LEG ULCERS

## A Clinical Study of Their Etiology and Treatment

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THE purpose of this presentation is to record conclusions and opinions on indurated leg and leg ulcer arrived at after a large experience over a period of some 20 years in the management of vascular diseases affecting the lower extremity. Included in this clinical experience are numerous cases of varicose veins, indurated legs, leg ulcers, thromboangitis obliterans and other vascular diseases. After many years of working with these problems one is bound to reach certain crystallized conclusions at times conflicting sharply with views frequently expressed in the literature at other times in perfect agreement with commonly recorded doctrine.

An attempt will be made to present the subject as a composite problem intensely complex and including all the various factors which might influence the lower extremity ultimately to become the seat of some pathologic process which leads to induration and then ulceration. When any individual problem of this sort presents itself the potentialities of its causes and treatment, if viewed broadly and more or less completely will help in its solution. Each individual problem is usually very intricate and does not represent merely one phase with out variations or influencing factors other than those immediately apparent. It is important to think of these problems in a projected fourth dimension not only what the leg looks like objectively now but what it will look like in 15 or 20 years unless certain component causes which have influenced it and which will continue to influence it in the future are changed. When one sees a small leg ulcer particularly on a young individual or a post thrombophlebitic edema 2 months after a deep vein thrombosis has occurred it is helpful to

think of other cases of this type but 15 years farther advanced. Thus the course of the new case of postthrombophlebitic edema may be projected into the future with its complications and end results. With such consideration it is possible to envision various measures and advices which may be given to prevent as far as possible the development of more advanced stages of the same process.

If a doctor is to manage such a problem in an optimum manner, not only must he have knowledge of the various therapeutic measures which may be employed, but he must view even the minor processes such for example as varicose veins with a little scaly dermatitis near the internal malleolus not only as a stationary pathologic condition but as one whose factors will continue to operate chronically over a long period of time. These diseases are all chronic. They may be seen in an early or late phase but almost invariably the tendency for them is to progress and to become more severe. This is a basic truth which when firmly realized must strongly influence the doctor in his instruction to the patient and in his judgment as to the therapy for the condition as it presents itself before him.

By indurated leg is meant any hardness or thickening of the skin and subcutaneous tissue resulting from edema. Positive factors which influence the development of indurated leg and ultimately leg ulcer may be grouped under nine headings in this classification based on etiology: (1) postthrombophlebitic edema (2) varicose veins (3) obesity (4) trauma, (5) infection (pyogenic or fungus), (6) lymphedema (7) immersion leg (8) arteriovenous communications (9) systemic causes.

Usually any indurated leg has at least two and sometimes three or four of these different factors responsible for its development. Frequently trauma is an additional factor in the development of an ulcer on a leg which has

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long been the seat of postthrombophlebitic edema. Less often three factors such as varicose veins, obesity, trauma and sometimes a fourth invasion of trichophyton, are found as responsible etiologic causes in the same patient. Perhaps the most interesting of all the problems of leg ulcer and indurated leg are those in which the underlying primary cause is something far removed and of a systemic nature for example cardiac decompensations resulting from garter may be an incipient factor in the development of the leg condition. Often these patients are not aware that the onset of their leg trouble is so indirect.

In the management of these patients of course it is very important to have a detailed history and very carefully done physical examination and preferably to look at the problem not once but at several different times. Often this will lead to a more accurate conclusion and thus facilitate judgment in the treatment. In selecting different measures for treating an individual case it is well to review again the different factors which are responsible for such changes in the leg. Each and every one of them should be obviated as far as possible. Sometimes an attempt to control a condition of this sort is ineffectual when the treatment is directed against the most obvious factor only and when other causes, less obvious, but nevertheless very potent are left alone.

One ought to be well aware of the many different therapeutic measures which can be used locally systemically and regionally in controlling these lesions. These too may be classified under a number of different headings as follows

- Position—rest
  - a. Elevation
  - b. Intermittent recumbency—interruption of period of leg dependency
- 1. Local pressure
  - a. Unna paste boot
  - b. Compression bandages, ace type—sponges
  - c. Elastic stocking
- 3. Local applications to ulcer
  - Dyes—(3%) aqueous solution gentian violet; scarlet red; zinc oxide; zinc peroxide; bismuth powder; dried red blood cells; thyrothrycin; sulfonamide crystals; sulfathiazole and urea; penicillin, streptomycin and many other medications.
- 4. Temperature (optimum—neither cold nor heat, room temperature)
- 5. Chemical or operative interruption of the sympathetic nerve impulses resulting in vasodilatation.

- 6. Systemic therapy—antithrombotic therapy cardiac therapy other drugs and operations directed to correction of a systemic factor. Systemic vasodilators tetraethylammonium chloride ether alcohol, tocopherol
- 7. Anticoagulants
  - a. Dicumarol
  - b. Heparin
  - c. Heparin in Pitkin menstruum leeches
- 8. Ligation of veins
- 9. Grafting of ulcers with or without excision of ulcer bed
- o. Konodon or similar operation with or without skin grafts

When a knowledge of the range of effective measures is considered with the factors responsible for the indurated leg the proper outline of the management of the case may become very problematic and interesting, challenging one's information, judgment, and technical ability. Certainly the treatment is something more than just dressing a leg ulcer.

#### TREATMENT

The treatment for indurated leg and leg ulcers can be divided into preventive and active. This involves a very broad scope for in reality prevention of indurated leg means the prevention of anything which might create a persistent or recurrent edema of the leg. Preventive treatment includes the consideration of all approaching factors which ultimately might lead to persistent swelling of the leg including the prevention of excessive obesity postoperative thrombosis, trauma to the leg, infection and other such factors. The prevention of the indurated leg necessitates also the consideration of the means of removal of factors which have already been established and which created edema in the leg. It involves the knowledge of the active measures which might be employed at the time of thrombosis of the deep veins of the extremity.

The physician and patient must have the proper regard for danger signs such as edema persisting after injury from even slight trauma. If allowed to recur day after day this may result in a hard area and years later in a spreading induration with eventual ulceration whereas if it is taken care of promptly and properly with adequate rest at the time to permit the tissues to heal, the condition may subside and disappear entirely. It is well to recall that the tissue vitality of the skin varies at different

regions of the body. On the face and neck an incised wound heals very rapidly. The blood supply is good, the vitality of the skin is comparatively high and it is feasible to remove stitches early. On the other hand, on the abdomen the skin heals much less readily and stitches must be left in longer. The vitality of the skin in the region of the ankle is the lowest for any region of the body. Incised wounds heal slowly here, bruises disappear less readily and swelling has the tendency to persist longer. It is natural for a patient to regard a furuncle of the hand and a furuncle in the region of the ankle of similar importance. Such however is not the case. A furuncle in the region of the malleolus particularly in an obese individual may result in a thickened, hard, subcutaneous area with spreading induration. To heal a lesion of the leg requires more time and rest with intermittent recumbency than it does to heal a similar lesion in the region of the wrist. If proper regard is not had for these physiologic facts the patient with edema of the ankle resulting from an infection due to trauma or furunculosis may have this edema persist day after day with eventual induration of the leg in that area.

#### POSTTHROMBOPHLEBITIC EDEMA AND ULCER

Postthrombophlebitic edema ulcers are among the most common ones seen in private practice. The reason for this becomes apparent after a little study and consideration. Varicose ulcers which are also common usually can be healed by external pressure or by operation to ligate the veins. Compression bandages or elastic stockings are appliances employed successfully by patients with varicose veins and varicose ulcer. Usually the ulcer will respond to such therapy because the compression appliance not only prevents edema by pressure on the ulcer but in addition to that it compresses the varicose veins and prevents the retrograde flow of blood. In other words it improves the circulation. On the other hand ulcer resulting from postthrombophlebitic edema is not as readily improved with external pressure. The edema there is due not to retrograde flow as in varicose veins, but it is back pressure attributable to two

factors obstructed return channels increasing the intercellular pressure and dependence of the part which adds the gravity factor to the already increased intercellular fluid. Postthrombophlebitic ulcers are usually very painful and the patients complain bitterly and suffer from them. They are not well tolerated even by indolent individuals.

The preventive treatment of postthrombophlebitic edema of course is to prevent the thrombosis. One of the most effective advances made in this regard is the employment of 'early ambulation'. Undoubtedly getting patients out of bed early after operation and parturition is a big help in preventing thrombosis in the veins of the lower extremity. Active movement in bed, leg exercises are physical factors which also help to prevent thrombosis. It has long been realized that getting a patient up early after ligation of varicose veins will reduce the incidence of pulmonary embolism. Only more recently has this same trend been widely used for most other surgical operations.

Anticoagulants in the prevention and treatment of thrombosis have their advocates, and justly so. There is ample evidence reported by men who have used these drugs in large numbers of cases to show that the incidence of thrombosis and pulmonary embolism is remarkably reduced by their employment (Allen, E. V. Jorpes). These drugs are used more often as a therapeutic than as a preventive measure. Reports of their effectiveness in preventing the propagation of a thrombus and in the prevention of pulmonary embolism compare favorably with the results of surgical measures for this same purpose.

To prevent pulmonary embolism in elderly individuals preliminary deep vein ligation preceding a major operation has been used and advocated by the Massachusetts General Hospital Group (Allen, Arthur). As a method for active treatment of thrombosis of the deep veins of the lower extremity, ligation of the femoral or iliac veins is being enthusiastically employed in some institutions and ignored in others. This measure has not been wholly accepted by the profession but it deserves a proper place. A most important consideration is whether interruption of the deep veins at

the time of thrombosis will lessen the magnitude of postthrombophlebitic edema or increase it. My experience leads me to believe that interruption of a deep vein in the thigh never can be done with absolute impunity. There is always some residual edema from interruption of the femoral vein. This may not be apparent on restricted activity but it becomes apparent on forced activity. If a patient who has had such a ligation had to work a period of 16 or 18 hours a day the edema would most assuredly manifest itself long before the end of the day. In reality the return circulation in an extremity in which the femoral vein has been transected is always less efficient than it is in a normal extremity. But the question as to whether operation increases or diminishes the tendency to edema after thrombosis has occurred has not been definitely determined. It possibly increases it if the thrombus is small and diminishes it if the thrombus is massive provided in each instance the thrombus is removed at the time of ligation. When there is an extensive thrombus involving a long segment of the femoral vein with massive edema of the leg transection of the vein and removal of the thrombus with ligation may permit better development of collateral circulation during convalescence and eventually a more efficient return circulation than if the huge thrombus is left there to organize and obstruct a larger segment of the vein. My own indications for interrupting the femoral vein for thrombosis are two: when any sign of pulmonary embolism has manifested itself ligation is immediately done to prevent a major embolus; second when there is an extensive thrombosis resulting in a massive swelling of the leg the thrombus is removed and the vein is ligated with the intention of diminishing postthrombophlebitic edema.

The active treatment for postthrombophlebitic edema is a question of much debate. It demands a selection from numerous different measures, none of which are entirely specific. The results are not uniform, sometimes surprisingly good but sometimes disheartening. This regards only the well established edema in the chronic stage following thrombosis of the deep veins of the lower ex-

trinity. It is a fact but rarely acknowledged that the return circulation of these extremities can never be expected to assume a perfectly normal capacity. In addition to this the resolution of the process involving as it does the development of collaterals and the organization and recanalization of the thrombus is one which takes a long period of time. It has been my policy to tell patients who have developed a deep vein thrombosis that it will take them a minimum period of 6 months to recover from it. This may seem like a discouraging statement to the patients but on the other hand it gives them an understanding of the difficult problem of re-establishing circulation. The patients must be made to understand that all during this time the circulation is improving. If they make excessive demands on their circulation by keeping their legs dependent an undue number of consecutive hours the daily recurrent edema may eventually lead to an indurated leg. It is not the number of hours in twenty four which a patient works that may precipitate induration of an edematous leg; it is the number of consecutive hours of dependency. If a patient will interrupt the period of time which he is on his feet by lying down and elevating them, part of the edema will subside and the total edema resulting at the end of the day will be less than if the whole day is spent ambulatory. It is very important for the patient to realize that 'resting the leg' by putting it on another chair when he is sitting down is ineffective and almost inconsequential. The leg is still dependent. If a means of elevating the leg above the heart while he is sitting in a chair can be devised it may do some good. Otherwise he must lie down and elevate the leg above the cardiac level. During the convalescent period immediately following thrombosis it is well to advise patients to interrupt the period of dependency by mid morning rest for a period of an hour and a mid afternoon rest for an hour. This recumbency must be in bed and preferably part at least of that time the affected leg should be elevated. After a period of time when there is less tendency for edema they may have insignificant swelling if they rest only at the mid-day. They should continue these interrupted rest periods for a

to 6 months. If patients carefully follow this regimen even though they have had a severe deep vein thrombosis, the residuals such as pigmentation and hardness in the region of the malleoli will be absent or minimum. In spite of this it is well to caution that if they ever get a laceration or a bruise or infection on that leg they must regard it with a certain amount of seriousness. They must respect it much more than if it occurred on the normal leg. In this way they may prevent trouble. It is much more important for them to go to bed if they have an associated factor such as laceration or bruise than it would be had this injury occurred on the opposite normal leg.

Ulcer resulting from postthrombophlebitic edema is extremely painful and extremely disabling. If it has not been prevented and does occur, the patient will probably have to fight its recurrence even though it responds to therapy and heals promptly. He usually has to combat recurrences the rest of his life. The prevention of it, therefore, is highly important. If it has already occurred various local measures may be employed. It is my experience that ulcers in different individuals though they all be fundamentally postthrombophlebitic ulcers, may respond with great variations to various local measures. Among the agents which might be used are the dyes including gentian violet (2% aqueous solution) scarlet red (ointment) penicillin streptomycin sulfonamides urea zinc peroxide tyrothrycin dried red blood cells zinc oxide bismuth powder Unna paste boots and others. Almost everyone who handles these measures has a favorite. I should like to endorse dried red blood cells which at times are very effective. In addition to that the use of gentian violet in a 2 per cent aqueous solution at the same time avoiding soaps and water usually works well. On the other hand it sometimes increases the dermatitis and makes the ulcer spread. Similar ulcers in different patients seem to have no unanimity of response to these local measures.

In addition chemotherapeutic agents systemically such as penicillin and sulfonamides are measures which should not be overlooked. Very frequently a period of bed rest with several spaced procaine lumbar sympathetic

nerve blocks will help to reduce the edema and to obviate the pain of the ulcer and to facilitate its healing.

If postthrombophlebitic ulcers have been long standing or have recurred a number of times and if the area of induration is marked, extensive excision of this whole zone including the head of the ulcer through the fascial layer and down to the muscles with the replacement of a split thickness skin graft has given us most gratifying results. Our experience with this type of operation has been very satisfying (Figs. 2, 3, 4). In 90 per cent of cases the patients were returned to work and have had no further trouble with ulceration in that area. The freedom from pain is a gift for which they are most appreciative. In addition the deformity resulting from excision of the area is in reality very mild. Usually after a period of time the zone is well graded with the surrounding tissues and the graft is relatively inconspicuous. It is very important to excise the entire indurated area and remove the fascial layer down to the bone or muscle. This seems to give a new base for the skin which so easily ulcerated previous to operation. Undoubtedly the deep circulation now takes care of the blood supply which was so deficient prior to the operation due to scarring. The center of the graft after operation is extremely soft for the base of it is the well vascularized underlying muscle. We usually take out a relatively wide area extending up the leg to the junction of the middle and lower third or to the middle of the leg. We have removed it over the malleoli and down to the sole of the foot. This is an operation which undoubtedly as it is better known will be more widely used for these cases. It may be employed for varicose ulcers as well as postthrombophlebitic ulcers, but it is more frequently indicated in the latter.

Just a word to warn against the ligation of superficial veins when there is a definite history of deep vein thrombosis. If compensatory varicose veins develop in a leg which has been the previous site of a deep vein thrombosis it has been my experience that ligation of them usually does not help the return of circulation and frequently makes it worse. We have had no personal experience in the

transection of deep veins for postthrombophlebitic states as reported by Buxton and Coller. It is hard to read satisfactory results in the reports of these authors. They apparently do not enthusiastically advocate the method. A study of the type which they reported is justified in one or two large medical centers but the procedure should not be used indiscriminately and sporadically until its worth has been proved by reports from several medical centers which acclaim its value.

#### VARICOSE VEINS

An individual with severe or moderately severe varicose veins should be regarded as a 'prestage' of indurated leg. Adequate treatment should control the retrograde flow of blood in the superficial varicose system. The comparative tourniquet test (Afshorner-Ochsner test) will usually point out the improvement to be expected prior to ligation and segmental resection. When varicose veins are operated upon, the fundamental part of the procedure is a high ligation at the fossa ovalis resection of a small section of the saphenous vein and separate transection and ligation of the adjacent tributaries. In addition to this, if the comparative tourniquet test shows incompetence of the valves of the veins communicating between the deep and superficial systems below that level additional ligations or segmental resections should be done to control most of this back flow. In considering this operation in the light of an indurated leg it may be regarded as preventive surgery. In reality of course there may be other indications for the ligation.

Usually the onset of induration of the leg in a patient with varicose veins is manifested by thrombosis of a small vein in and around the malleolus at the lower end of the saphenous system. In that area edema and hardness appear. The area may become discolored and even pigmented. It may be tender. This should be regarded as a danger phase. External compression and interval rest in the middle of the day will probably help to restrict the spread of induration. If the patient ignores these signs staying ambulatory many hours a day the swelling may recur daily and subcutaneous tissue may become hard in that

area. Eventually fibrosis and scarring with persistent dermatitis, scabiness, and weeping of the skin may result in an ulcer.

When this stage presents itself it is imperative that the varicose veins be ligated in order to improve the circulation and to stop the retrograde flow (Fig. 1). Even if ulceration has supervened, ligation becomes a basis for therapy. As long as the circulation is unpaired with chronic passive congestion of the tissues the pathologic process will progress. Local applications to the ulcer are of much less fundamental importance in the average case. However if a patient has any condition which precludes the advisability of surgery the compression therapy with elastic stocking or temporary Unna paste boot may be accepted. Severe varicose ulcers with induration which persist after ligations should be excised and the area grafted with skin (Fig. 2).

Unless small intracutaneous varicose veins without large rosy varicosities have developed a complication such as thrombosis ligation will probably not improve them sufficiently to justify its being done purely for a cosmetic reason. This statement of course is made in respect to a lower extremity which is the seat of the varicose veins of the small intracutaneous telangiectatic variety only. When they are large dilated saphenous veins or other trunks with marked ectasia the improvement in the circulation may be marked following ligation. Moreover small superficial intracutaneous varicose veins will not respond properly to injections of sclerosing solution. Usually the patient with these is seeking cosmetic improvement. If they are injected with a sclerosing solution it is true the small varicosity may disappear. On the other hand there will be a discolored area leaving a spot which is as cosmetically imperfect as the varicosity. It is my policy to advise patients with small varicosities, who are seeking cosmetic improvement only to let their veins alone.

When varicose veins are moderately severe or severe ligation at the proper level is the treatment of choice. Then improvement in circulation efficiency may be expected. Either varicose veins are severe enough to justify ligation or they are mild and should be left untreated because they cannot be improved



Fig. 1. Varicose ulcer before and after ligation of the saphenous vein. The ulcer healed promptly after the li-

gation. It had been present almost continuously for some 2 years prior to ligation.

cosmetically. If they progress and become more severe ligation can be done at a future date. It seems always fair and even important to tell the patient that whereas varicose veins can be improved by ligation the tendency to develop varicose veins cannot thus be removed. Patients with obesity and superficial varicose veins should be warned against striking their limbs against chairs or other objects. In addition if they have even a minor injury resulting in thrombosis they should be carefully cautioned to interrupt the period of dependency of their legs and elevate them for

an hour or more during the middle of the day until the swelling disappears. Compression therapy in the form of a semielastic bandage (elastoplast or ace bandage) at this period is frequently very helpful. If varicose veins are present and if thrombosis occurs in the varicosities the thrombosis is an additional indication for surgery. When ligations at the proper sites are done for the varicose veins after thrombosis occurs in the varicosities the dual effects of the operation are subsidence of the thrombosis and improvement of the varicosities.

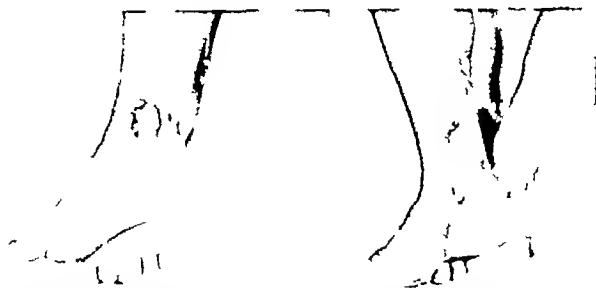


Fig. 2. Varicose ulcer before and after excision and skin graft. The patient's varicose veins had previously been ligated but prior to ligation the indurated area had been present so long and so much scarring was present that she was not able to prevent the skin from repeatedly breaking open and ulcerating. Following excision and skin graft she has remained well for over a year in spite of the fact that she is a nurse.

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Fig. 2. Varicose ulcer before and after excision and skin graft. The patient's varicose veins had previously been ligated but prior to ligation the indurated area had been present so long and so much scarring was present that she was not able to prevent the skin from repeatedly breaking open and ulcerating. Following excision and skin graft she has remained well for over 1 year in spite of the fact that she is very active.





Fig. 3. An ulcer of the leg before and after excision and graft. The main etiologic factors here are obesity and trauma. She previously had minor intracutaneous aneurysms injected. The ulcer had been present for period of 5 years. After excision of the indurated area down through the fascial layer and application of the split thickness skin graft this patient has remained well. She is very well. The center of the grafted area is quite soft since underlying the skin there is muscle. This affords good vascularity in the surrounding area.

#### OBESITY

Obesity is a frequent factor in the development of indurated leg (Fig. 3). It is rarely of itself the only factor. Combined with trauma, thrombosis, infection, lymph stasis, or systemic causes of passive congestion such as cardiac disease, it may exert its effect in such a manner as to increase edema and bring about fibrosis of the subcutaneous tissue. Patients who are obese have a tendency to thrombosis. If they have varicose veins, they should be cautioned about the dangers of even slight trauma which might precipitate a thrombosis and lead to induration. In addition, localized infections such as furuncles on the lower extremity in the obese patient should be respected as conditions much more likely to lead to chronic trouble than if the same process occurred in a patient of normal weight. Once established, erysipeloid with its recurrent infection and high fever has a fertile soil in the obese leg. These repeated infections lead to chronic swelling and eventually to thickening of the subcutaneous tissue.

The preventive treatment of indurated leg as far as this factor is concerned involves the prevention of obesity with all of its difficulties. In addition to that, it involves the prevention of other associated factors such as injury or long continued dependency which might in-

crease the tendency of the intracellular fluid to become static and pool in and around an obese ankle. Whenever an obese patient develops the slightest additional complication such as a small thrombosis in the vein of a lower extremity, he should be cautioned to treat the condition as if it were something potentially very serious. Compression therapy and bed rest may help it to resolve and prevent it from becoming chronic.

#### TRAUMA

Trauma may be the incipient cause of indurated legs in several different ways (Fig. 4). Even slight blows to the subcutaneous tissue, particularly around the internal malleolus, may result in edema. Apparently at times this edema of the subcutaneous tissue and overlying skin is not attended by any thrombosis in the veins. There is undoubtedly a vascular disturbance which may be so severe that vasospasm of the veins and arteries of that extremity is a decided factor in the persistence of edema.

One frequently hears the story of a patient aged 50 that some 15 or 20 years ago struck his leg on a sharp corner of a rocker. It hurt and was annoying at the time but the patient was very busy and had to continue working for many hours a day. The swelling continued day after day. He felt that it should disappear spontaneously. Perhaps he did not even go to a physician, but if he did he probably did not foresee the ultimate end result, namely, an indurated leg and ulcer. To prevent induration of the leg from such causes, the patient should respect the possibility that the effects of the injury may become chronic. He should rest in the middle of the day with the leg elevated and should use compression bandages of the ace type, or if the trauma has been severe enough he should remain recumbent most of the time for a period of a few days.

Another type of trauma which results some times in an indurated leg is that from a more severe injury such as a fractured femur or a fracture of the tibia. Hardness and induration of the subcutaneous tissue around the malleoli are commonly seen as sequelae of these injuries. There are probably two different pathogenic

onsets for induration resulting from such trauma. One is that which accrues from injury to the deep vein with thrombosis at the time of the fracture. Because the patient was lying in the bed with the limb elevated the immediate consequences of this thrombosis of a large collecting vein may have been overshadowed by the objective evidence of the fracture itself. Only in the convalescent period after union when the patient was becoming rehabilitated was it noticed that the leg swelled inordinately.

Injury to the lymphatics and smaller veins in the region of the ankle attending the fracture of the tibia may cause considerable chronic disturbance in the circulation and tendency to subcutaneous edema persisting long into the convalescent period. Interrupted dependency and external compression bandage during this phase is very very important. All of these injuries are attended with vascular disturbances with vasospasm. Even minor injuries may have a posttraumatic syndrome equivalent to Sudeck's atrophy with edema and eventually with atrophy of bone and persistence of the pain.

The active treatment of the edema which results from trauma is rest and elevation either constant or interrupted whichever may be necessary. As a supplementary measure external compression is very valuable. Sometimes temporary interruption of the sympathetic nervous impulses by procaine lumbar sympathetic nerve blocks is of great value. Careful judgment should be used in selecting different measures but in all instances great respect should be exercised when edema is occurring day after day. If it does so and does not abate indurated leg is inevitable.

#### INFECTION

Infection has been mentioned a number of times as a partial factor operating with other factors in the production of indurated leg. One should recall to mind the tissue vitality of the skin of the leg. It is relatively very poor. Any infection there resulting from an open wound or furuncle is apt to heal very slowly. Resolution takes much more time and an important part of the preventive and active treatment of such lesions is to regard them as being



Fig. 4. Resultant of excision and skin graft of an ulcer of the leg which according to the history followed a bruise to the leg in the region of the ankle. Apparently trauma had been a major factor in this ulceration. No previous photograph is available but the ulceration was extremely painful. This patient, aged 36 years, is an active business woman. Since her graft in July 1946 she has remained well.

potentially more dangerous and more likely to develop into chronic stages than are similar lesions elsewhere on the skin of the body.

Infection in the skin in the form of a recurrent erysipeloid or erysipelas is an extremely dangerous extremely disabling illness. The attacks tend to recur after a period in which the host has been very active. Practically all of the attacks begin at one spot. The patient describes an itching sensation and then usually an onset of a chill with high fever. Within a few hours the leg is intensely red and very painful and the patient is extremely sick. The repetition of the infection over and over again results ultimately in much hardness of the leg skin and subcutaneous tissue and sometimes in ulceration. We have used sulfonamides, penicillin and other measures in an effort to prevent the attacks. None of these measures have worked entirely satisfactorily. In one instance in a young man who was having recurrent attacks of erysipeloid I excised the trigger area. We studied carefully the onset of the trouble. Each attack seemed to begin around the malleolus. The following is his history.

M. S., a young man aged 19 years, came under our care on August 2, 1946. For 6 years he had attacks of chills and fever accompanying painful swelling of the left foot and leg. The last attack had



Fig. 5. Congenital lymphedema in an old child. There is a thickening of the dorsum of the left foot and slight increase in size of the left leg. The middle of the calf. The ulnar nerve (tissue on the dorsum of the left foot including the ulnar nerve) excised through the ulnar nerve-shaped incision. This patient died prior to operation but has been observed now for several years. The result is excellent. A slight thickening of the left leg persists. Since congenital lymphedema often leads to subsequent attacks of erysipelas, conditions such as this should be treated surgically early in life. The photograph shows the legs preoperatively, and 20 months after operation. (J. J. Murray, 1945, this patient now aged 9 years, had first attack of erysipelas induced by epidermophyton.)

been J. 1946. The condition flared up again at the time of a recurrent erysipelas. Examination at the time he was first seen revealed negative findings except for slight thickening of the subcutaneous tissue in the lower half of the left leg from the calf to the ankle. He was asked at this time just where the first signs of the infection appeared. He was not certain but he thought that the attack began in the region of the ankle. He was sent home advised to take 500,000 units of penicillin once a week for a period of 6 weeks. On December 4, 1946 he returned again from his home in another state. He had had a final attack. At this time it was observed by him in the recent attack that there always began in the region of the medial malleolus.

It was decided then to excise a area of skin ulnar nerve and fascia zone in which the attack was thought to begin. On December 4, 1946 this was done. A split thickness skin graft was taken from the right thigh and was placed on the ulnar nerve. In addition in order to improve the circulation to the lower extremity a left lumbar sympathectomy was performed December 20, 1946. A report from the patient received November 1947 states that he has had no attack of erysipelas since the operation except for mild one. September 1947 which was initiated after excessive exercise. He attended in result a little that he is able to be an active child.

We felt that the etiology of this man's condition was an acquired lymphedema. Whether

the lymphedema followed the erysipelas or whether it was a primary factor with a superimposed recurrent infection we were not able to determine from the history. There is no familial history of lymphedema in his case.

In addition to the bacterial types of infection which may be factors in the development of the indurated leg, one should consider trichophytosis as a common secondary invader to a chronically edematous skin. It is not easy to prove this each time by laboratory methods. On the other hand it has been proved that fungus of this type may affect the skin. It usually does so in the region of the internal malleolus. It is necessary to combat onychomycosis and trichophytosis of the feet in patients with recurrent or persistent swelling of the leg and with a scaly dermatitis of the malleolar region. In a very warm climate one gains the impression that this fungus is very widespread and very common. It is abetted by moisture and in its presence soaps and water seem to enhance the pathologic process. Apparently at times the fungus infection of the trichophyton variety may be the initial and only cause of the leg ulcer. It is true that without other complications this lesion may fall into the category of dermatology but one handling leg ulcers cannot help being impressed with fungus invasion as a factor in the development of leg ulcers.

#### LYMPHEDEMA

Lymphedema may be familial or it may be sporadic. It may be acquired later in life or it may be congenital. If it is seen early in life and there is a family history of it it may be termed Milroy's disease or Nonne-Milroy disease. If there is a family history of it and if it presents itself at puberty, it may be regarded as Meigs's disease. Moreover it may be secondary the result of obstruction of major lymphatic channels from repeated infection or by parasitic invasion namely filaria.

The condition may be a diffuse thickening of the subcutaneous tissue of the leg or it may be localized subcutaneous deposit with ectatic lymphatics, fat and fibrosis. If it is observed early in life the tendency for it is to advance and become more severe as the child grows older. Many of these patients have

very little trouble from it. It is much more common than is usually appreciated and with out complications it may interfere little with a very active life. On the other hand it is fertile soil for infections.

Measures to prevent a leg which is the seat of lymphedema from becoming indurated involves an effort to avoid all associated factors. When any complications appear they should be treated cautiously and with full knowledge that they may change the process into one which could be very disabling. Should induration and ulceration appear the active treatment may mean excision by a Kondoleon type of operation. Even before ulceration excision particularly of localized lymphedematous masses may be indicated.

I believe that when localized sporadic lymphedema is present and seen early in life it should be excised. The following is a brief abstract of such a case.

The child (F P) aged 2 years when first seen had a marked swelling on the dorsum of the left foot. It had been present since birth. The swelling seemed to be increasing in size and because of it a shoe could not be worn on that foot. The swelling was soft was never painful.

When examined the patient showed a diffuse soft swelling of the foot involving the dorsum and extending to the ankle. It was about 2 centimeters thick in its greatest depth and was about 6 by 6 centimeters in the other dimensions. In addition to that the left leg was slightly larger in circumference than the right. The subcutaneous tissue was thicker than normal but not hard. The condition was regarded as congenital lymphedema. The child was kept under observation for 1 year. Then an operation was performed.

Through a horseshoe incision elevating the skin the whole zone of thickened subcutaneous tissue was excised including the fascia. The skin was then replaced. The wound healed promptly and the child has made an uneventful recovery. She has developed normally. She has been observed at intervals for 5 years since the operation. The result is excellent (Fig 5). Pathologic examination of the section removed revealed fat dilated lymphatic spaces and fibrous tissue.

The onset of recurrent erysipelas in a patient with lymphedema of the lower extremity leads to a very serious point in judgment. When lymphedema is severe a Kondoleon type of operation may be of great advantage in relieving the enormous swelling. If the trigger zone could be excised at the same time the



Fig 4. Immersion leg. Chronic swelling and thickening of the subcutaneous tissue with ulceration of the leg which was initiated after this officer had to lie immersed in water for a period of 30 hours during an invasion. This condition was treated conservatively mainly by restricted activity. Since returning to civil life he had been very active and consequently had daily recurring edema of the lower extremities. Impaired circulation such as this will not withstand many consecutive hours of dependency.

recurrence of the attacks may be obviated. I believe that if these patients can be seen soon after the onset of recurrent erysipelas some effort should be made to excise the zone in which the infection lies dormant during remissions. We have tried giving patients various chemotherapeutic measures to reduce the number of attacks or to obviate them. Usually it is not successful but in a few instances we have seen apparently what amounts to a cure that is cessation of the attacks of infection in the leg with fever. I have seen patients who I thought were better off to have an amputation because of continued disability from recurrent erysipelas than to try to keep the lower extremity. Usually when told this they are very reluctant even though they have spent many months out of the last year convalescing from an attack.

#### IMMERSION LEG

The name immersion leg is intended to designate chronic edema of the leg which results after the trunk or lower extremities have been immersed in water for many hours or days. This injury resulted many times during war when boats were torpedoed and survivors were picked up after they had been immersed in

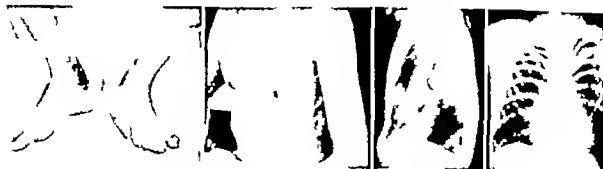


Fig. 7



Fig. 8

Fig. 7. Lower legs partially the result of an indirect trauma. The patient had a car accident funnel head with displacement of his heart and interference of his return circulation resulting in chronic edema of the legs which he said as present prior to the operation.

Fig. 8. Postoperative view of patient lower in Figure 7. He felt better than he ever had before and now eight pounds more than he ever weighed before. The ulcers present on each leg have healed and have not recurred since the operation.

water for many hours. The following brief history is typical of these cases:

Case 1. H. aged 47 years with a history of the following: His company was organized with the enemy for 36 hours he was lying half in the water and half out. The temperature at the time was moderate. After he then his legs have been swelling. After his return to civil life he has a usual life for a harbor pilot. This requires him to work many hours a day in some heat and when he lies so the swelling is pronounced. Recently an ulcer has appeared near the distal malleolus of the right leg. Examination revealed tremendous swelling and induration of both legs below the middle of the thighs (Fig. 6). A small leg ulcer was present near the right external malleolus. Thorough investigation revealed that he did not have filaria. A scaly dermatitis was found on both legs above the ankles suggesting a fungus infestation of the skin condition he himself termed "jungle rot." The treatment advocated was conservative with more restriction of activity.

The cause of recurrent edema after immersion in water is obscure. Apparently the ves-

sels lose their tone and the tissues are damaged so that intercellular spaces remain open and subject to ready filling.

#### ARTERIOVENOUS COMMUNICATIONS

Any condition in which the arterial blood is emptied directly into the larger veins may lead to edema and eventually to induration and ulceration. Arteriovenous communications are mentioned to make the classification comprehensive. If the lesion is congenital or occurs early in life from trauma the lower extremity is likely to be longer and larger than the opposite. The diagnosis when an arteriovenous communication is large enough to result in edema should be more or less obvious. If induration alone is the symptom presented, diagnosis of arteriovenous communication will not be overlooked if it is remembered as a possible cause. The proper treatment is surgical attack on the arteriovenous communication.

## SYSTEMIC CAUSES

It is surprising sometimes to find the cause of an indurated leg far removed anatomically and even physiologically. I have seen a patient whose chief complaint was indurated leg, and leg ulcer and the fundamental cause behind this predominant problem was a nodular goiter with hyperthyroidism. The patient had been having mild cardiac decompensation with edema of the legs. The edema had resulted in induration in the region of the internal malleolus and ulceration supervened. Even more interesting was a patient sent because of leg ulcers. His history is as follows:

J. M. aged 25 years developed an ulcer on the right leg 10 years ago. Several injections were given in the veins and the ulcer healed. Since that time ulcers have developed on both legs in the region of both the internal and external malleoli. His legs swell almost daily. From birth he had a marked depression in the center of his chest.

Examination revealed a tall young looking man. He had a most pronounced funnel chest. There was extreme depression of the sternum at the lower end. In addition to this he had leg ulcers on both legs near the internal malleoli and pigmented indurated areas near the external malleoli which had been previous sites of ulceration (Fig. 7). Careful studies were done on this patient which will not be reported in detail here. We estimated that his circulation was deficient, partially due to the marked displacement of his heart to the left and possibly also due to pressure on the inferior vena cava by the retrodisplacement of the lower end of the sternum. On July 2, 1947 he was operated on for the funnel chest. The lower portion of the sternum was removed and after re-shaping it, it was replaced so that the defect was obviated. During his convalescence there was considerable drainage from the wound and infection supervened. We thought it was necessary to take out the graft which consisted of the lower end of the sternum and the adjacent cartilages. The wound healed. The ulcers in the meantime healed entirely. He was seen again in January 1948. The circulatory efficiency had improved remarkably. He weighed 10 pounds more than his previous maximum weight (Fig. 8). He felt better than he had ever felt. His venous pressures were lower than preoperative levels and were identical in leg and arm veins. Prior to operation the pressure in the leg veins at cardiac level was higher than that of the arm veins. The ulcers had healed following operation and ankle edema had disappeared. In January 1948 he had a recurrence of 2 ulcers on the right foot and ankle which appeared to be due to trichophyton. Edema of that ankle only was noted at that time.

Various other distant causes may be factors in the production of induration and ulceration

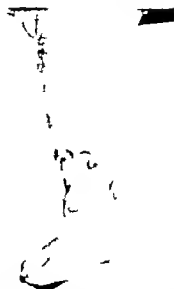


Fig. 9. Severe ulceration and induration of the leg. This is a neglected case of leg ulcer which has multiple causal factors including varicose veins and obesity. The subcutaneous tissue is thickened and very hard. Amputation is among the measures to be seriously considered for this degree of disability.

of the leg by interference with return circulation. For example cirrhosis and ascites and pelvic tumors which press on the iliac veins may initiate chronic passive congestion. In addition to this systemic factors such as diabetes and arteriosclerosis may be casual components in the development of leg ulcer and induration. These lesions rarely are the sole cause of leg ulcers but they may be a contributing cause and in order to heal the ulcer and prevent its recurrence all factors should be obviated as far as possible. Sickle cell anemia may be responsible for leg ulcer. Usually in this and some other systemic condition such as tuberculosis ulceration appears first and induration is a secondary accompaniment. Syphilis is frequently a cause of leg ulcer and if it persists over a long period of time marked induration may result. Filariasis is a systemic parasitic infestation with localized lymphatic obstruction is not to be forgotten as a possible cause of acquired lymphedema.

## SUMMARY

A clinical viewpoint involving the classification of indurated leg and leg ulcers based on the etiology is given. These conditions should be regarded as chronic progressive processes. Various factors are usually responsible for any induration of the leg and leg ulcer. It is im-

portant in the management of these conditions to attempt to obviate each and every factor. The treatment is preventive and active. Preventive treatment usually involves a respect for the seriousness of daily recurring edema of the leg. Various measures to be used in prevention and active treatment were mentioned. Some indications as to judgment and selection of different measures were discussed. Emphasis was repeatedly placed on the importance of preventing the recurrence of swelling in the leg day after day. This is a predisposing factor to indurated leg and the patient should be warned of its potential seriousness.

A great deal can be done not only to prevent these conditions but also to control them and at times to cure them. Several individual cases were cited to illustrate the selection of surgical measures for some of these problems.

If a patient is entirely incapacitated because of an indurated and ulcerated leg and if the prospect of cure of the ulcer is poor amputation should be considered. Usually patient are repelled by such a suggestion but the truth of the matter is that they would be better off living without a leg than living only for it.

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# EDITORIAL

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JANUARY 1949

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### BRONCHIOGENIC CARCINOMA

**W**ITHIN a period of 35 years primary carcinoma of the lung has advanced from a position of obscurity as a rare curiosity to one of great frequency. There is even some evidence now to indicate that it has displaced carcinoma of the stomach as the most common visceral cancer. Statistical studies at the St. Louis City Hospital and at the Charity Hospital in New Orleans (Ochsner and DeBakey<sup>1</sup>) have shown that actually primary carcinoma of the lung is more frequent than that of the stomach. This finding is of particular significance because these hospitals represent a cross section of the population of those two cities although at a lower economic level.

Because of its frequency it is important that great emphasis be placed on the desirability of early diagnosis and on the now well established fact that it is no longer an incurable or hopeless condition if the proper treatment is instituted at a sufficiently early time.

In regard to the diagnosis certain points should be stressed. It is primarily a disease of males (about 6 males to 1 female) during or after middle age. Since primary cancer of the lung practically always if not always arises in a bronchus the most common symptom is cough. In more than half of the cases the sputum sooner or later becomes characterized by streaks of blood. These two features are more pronounced if the cancer has arisen in a major bronchus. Unfortunately when it arises in a small bronchus at some distance from the main stem bronchus of either the lung or of any of the lobes both cough and bloody sputum may be absent. Such patients often have no warning of symptoms until the condition is too far advanced to be curable. As in other forms of cancer pain and loss of weight are usually late symptoms and often denote incurability. It cannot be stressed too emphatically that a middle aged man with an unexplained cough and bloodstreaked sputum should be strongly suspected of having a bronchiogenic carcinoma and that steps should be undertaken at once to make the appropriate examinations.

Of the methods of examination the most important are the x ray, bronchoscopy and the newer procedure of examining the sputum or bronchial secretions for cancer cells.<sup>2</sup> Even with a combination of these methods a definite diagnosis can be made in only about 85 per cent of cases. In the remaining 15 per cent it is necessary to perform an exploratory operation. Experience has shown, however, that in practically 100 per cent of cases when both the history and examinations are suspicious

<sup>1</sup>Ochsner A., and DeBakey M. *Surgery* 1940, 8:292

<sup>2</sup>Wandell, H. *in*: Study on Neoplastic Cells in Sputum. Copenhagen, Arnold Busck, 1944.



the tentative diagnosis of bronchiogenic carcinoma is found to be correct at the exploratory operation. It is dangerous in such cases to subject the patient to a period of observation waiting for the diagnosis to be established. Many curable cases are converted into incurable ones by such a procedure.

There was no successful treatment of this condition until 1933.<sup>1</sup> In April of that year the author of this editorial had the opportunity of performing the first successful one stage removal of a lung in a patient who had a squamous cell bronchiogenic carcinoma arising in the main bronchus of the left upper lobe. The patient is still living and well more than fifteen years later. Since that time the operation of total pneumonectomy has become the standard treatment for bronchiogenic carcinoma throughout the world. This procedure follows the rule of the surgical treatment of cancer of other organs in that a higher percentage of 5 year cures can be obtained if the whole organ rather than only a part is removed. It has the additional advantage over a mere lobectomy in that it makes possible the removal of more regional lymphatics.

During the fifteen years that have elapsed since the first successful one-stage pneumonectomy much has been learned about the curability of this otherwise hopeless condition as well as the limitations of the operation. Also of course the technical aspects of the procedure have been greatly improved (Rienhoff<sup>2</sup> and Crafoord<sup>3</sup>). Likewise as experience has accumulated much has been learned also about bronchiogenic carcinoma itself although the etiological factors and why the condition is chiefly one of the male sex remain obscure.<sup>4,5</sup>

Our own experience at the Barnes Hospital is based on a series of 1117 cases of proven bronchiogenic carcinoma from July 1, 1920, up to July 1, 1948. Since the first case of successful one-stage pneumonectomy on April 5, 1933 we have performed 296 operations of that sort of which 184 have been for malignant tumors. One of the most distressing features of the problem is the relatively small number of patients who present themselves with a cancer early enough to permit the removal of the lung. In our cases only about 25 per cent have had a pneumonectomy. We have probably been more conservative in this respect than some other surgeons. Space is too limited to permit here a discussion of this point except to say that we have not been convinced of the wisdom of going ahead with the removal of the lung when it is obvious that cancer tissue will be left behind. The chief deterrent factor however is usually the finding in those patients in whom exploratory operation has been done of invasion of the hilar vessels by the cancer, a condition which would make the operation not only excessively dangerous but futile as well. In a recent series of 360 cases we performed a pneumonectomy in 22.3 per cent. In an additional 32 per cent we carried out an exploratory operation but found the cancer too far advanced in our opinion for a resection of the lung. In the remaining approximately 45 per cent an operation was not performed because either the condition was obviously hopeless or other features seemed to preclude the chance of a successful operation such as advanced age or general poor condition.

Two questions of paramount importance are, of course, the immediate operative risk and the chance of a five year cure. It is gratifying that the operative mortality has steadily declined until now it is very respectable. In the early years it was 53 per cent but last

<sup>1</sup> Graham, E. A., and Sherr, J. *J. Am. M. Ass.*, 93: 1, 1927.  
<sup>2</sup>Rienhoff, W. F. J. *Bull. Johns Hopkins Hosp.*, 93: 53, 1900.  
<sup>3</sup>Crafoord, C. *On the Technique of Pneumonectomy in Man.* Stockholm: Tryckeri Aktiebolaget Thales, 1938.

<sup>4</sup>Graham, E. A., and Wornock, N. A. *J. Thor. Surg.*, 9: 5, 1944.  
<sup>5</sup>Graham, E. A. *Ann. Roy. Coll. Surg. England*, 9: 17, 1958.

year (1947) of 39 pneumonectomies for cancer we had only 2 deaths a hospital mortality therefore of only 5.1 per cent. Those who are more radical in their attempts at resection will have a higher operative mortality.

As regards late results there is reason to be optimistic. Of our own series of 53 patients who had pneumonectomies prior to 1942, 15 are alive and well. This is a five year survival rate of 28 per cent. The next five year period will undoubtedly show better results because of the sharp reduction in operative mortality. After all, in the early years 53 per cent or 28 patients died of the operation and there was no chance therefore to determine how many of that number might have lived more than 5 years if they had survived the operation. This is to be contrasted with the present operative mortality of 5 per cent. Of the five year survivors in our series the highest percentage was in the malignant mixed tumors (57 per cent of 16 patients). In 22 cases of squamous carcinoma 3 patients (14 per cent) are alive 5 years later and in 15 cases of undifferentiated carcinoma 3 patients (20 per cent) are alive after 5 years. In those cases with invaded lymph nodes naturally the results are not so good. Yet some are still living. Of 5 patients who had pneumonectomies for malignant mixed tumor with node invasion 2 are alive more than 5 years as is 1 patient of 12 with squamous carcinoma and lymph node invasion. Obviously, as is true with cancer in general, the earlier the lesion the better the result, but involvement of regional lymph nodes does not make the prognosis completely bad.

In summary, one may say that bronchiogenic carcinoma is now recognized to be one of the most frequent forms of cancer. The operation of total pneumonectomy offers hope to those victims of this disease who prior to 1913 had no hope. Nowadays the principal problem in improving the results is to have

patients come for help early enough to permit the operation. This means education of the profession to the recognition of the frequency of this condition, the necessity of early examinations of a proper kind, and the fact that the early case is curable.

EVARTS A. GRAHAM

## MEDIASTINAL TUMORS

**M**EDIASTINAL tumors are relatively rare lesions. It is safe to predict, however, that the practice of making routine roentgenologic examination of the chest will establish the fact that mediastinal neoplasms are much more common than past experience would indicate. Bronchogenic carcinoma was regarded as a rare disease years ago but it is now known to be one of the most common forms of cancer. These facts suggest that other intrathoracic tumors may be of more importance than has been attributed to them in the past.

Accumulated data from Army experiences during the past war are not yet available. It is significant, however, that 109 patients were operated upon for mediastinal tumors at Army thoracic surgery centers in the United States during a period of approximately three years. This series did not include cases of mediastinal neoplasms of lymphatic origin such as lymphosarcoma, mediastinal Hodgkin's disease and similar conditions. It is of particular significance that in 94 of the 109 cases no clinical manifestations of intrathoracic disease were present; the tumor was found on routine roentgenographic examination.

Successful treatment of mediastinal tumors depends on their detection before clinical signs are apparent. Block excision as used in carcinoma of the breast, skin, and elsewhere is precluded because of the anatomic arrangement of the mediastinum. Successful surgical

therapy therefore, is impossible unless the lesion is localized and encapsulated.

In the past there was a tendency to 'watch' asymptomatic mediastinal masses. This policy for intrathoracic tumors was understandable when the risk of exploratory thoracotomy was considerable. It can be stated categorically however that at the present time the danger of exploration of the mediastinum is trivial provided the patient is in reasonably good condition and provided qualified anesthesiologists and surgeons are available.

The discovery of a mediastinal mass by routine roentgenologic examination with or without associated clinical manifestations demands positive diagnosis. Should no available diagnostic procedure provide an infallible method to determine preoperatively the exact nature of a mediastinal tumor only two therapeutic methods are available: radiation therapy and surgical extirpation. With few exceptions the only mediastinal tumor which will respond to radiation therapy is one of lymphatic origin (lymphosarcoma, Hodgkin's disease and others.)

Radiologists and surgeons experienced in thoracic disease should be able to predict, in the majority of cases, from roentgenographic and clinical evidence the presence of a lymphoma. These tumors have a tendency to produce clinical symptoms early and their appearance on the roentgenogram is rather characteristic. Properly employed radiation therapy is invaluable both as a therapeutic and diagnostic measure if a tumor of lymphatic origin is suspected. Disaster may be anticipated however if injudicious radiation is employed in all cases of mediastinal tumors.

The mediastinum may harbor almost any type of tumor. For practical purposes it is convenient to classify common mediastinal tumors in two varieties: anterior mediastinal tumors and posterior mediastinal tumors.

The most common anterior mediastinal tumor is a neoplasm of lymphatic origin. Lymphosarcomas, Hodgkin's disease, granulomas, and other lymphatic tumors usually have a characteristic pattern which would indicate the administration of a test dose of radiation therapy. It should be emphasized however that about one third of the malignant lymphomas are slow in their reaction to radiation. If after a period of approximately one month of adequate radiation therapy there is no change, thoracic exploration should be performed to determine the exact nature of the lesion.

Dermoid cysts and teratomas of the mediastinum are the second most common neoplasms situated in the anterior mediastinum. In discussing these neoplasms Harrington<sup>1,2</sup> simplified the terminology by employing the inclusive term 'teratoid tumors.'

The chief source of confusion in the diagnosis of anterior mediastinal tumors is the differentiation between lymphatic tumors, teratoid tumors, thymomas and bronchiogenic cysts. When academic pride is excluded there remains only the choice between the lymphoma group and all the others. If any doubt exists thoracic exploration should be performed to establish a positive diagnosis.

Posterior mediastinal tumors are chiefly of one common variety. Neoplasms of neurogenic origin are by far the most common. Kent<sup>3</sup> and his co-workers collected 105 cases in the medical literature. 29 cases were recorded in my Army experience.<sup>4</sup>

The incidence of primary nerve tumors of the mediastinum is unknown. Most of these lesions are found on routine roentgenologic examination and are asymptomatic. Occasionally nerve involvement may cause pain if

<sup>1</sup>Harrington, S. W. Arch. Surg. 90, 9, 667.

<sup>2</sup>Harrington, S. W. J. Thoracic Surg. 23, 3, 30.

<sup>3</sup>Kent, E. M. Blades, Brian, Valle, A. R., and Graham, E. A. J. Thoracic Surg. 44, 3, 6-6.

<sup>4</sup>Blades, Brian. Ann. Surg., 94, 2, 740.

the sympathetic chain is involved Horner's syndrome may be evident Too often however definite clinical signs of disease indicate the presence of malignant degeneration and inoperability

Once considered rare bronchiogenic cysts are now known to be fairly common Laipply<sup>1</sup> reported 35 cases in 1945 In a period of three years 23 mediastinal bronchogenic cysts were removed in Army hospitals These cases were all found on routine x ray examination Pericardial cysts may occur Thymomas are relatively rare These tumors are usually located in the anterior mediastinum in a substernal position However bronchogenic cysts lymphomas and thymomas may occur in either the anterior or posterior position

Other varieties of mediastinal tumors include fibromas (probably neurofibromas) tumors of thyroid origin tuberculomas cysts of the esophagus osteochondromas and other

unusual neoplasms Enlarged lymph nodes Boeck's sarcoid and aneurysms can be mistaken for mediastinal tumors

Until precise diagnostic methods are available therapeutic measures in the treatment of mediastinal tumors will remain limited to radiation therapy and surgical removal Tumors which respond to roentgen therapy are usually incurable others may be amenable to surgical extirpation

The choice between radiation therapy and surgical intervention will depend first upon the tentative diagnosis and second upon the danger of exploratory thoracotomy If roentgenologic and clinical evidence indicate the presence of a lymphoma a test dose of radiation should be given If improvement does not follow in due course thoracic exploration should be carried out unless the general condition of the patient precludes the use of any type of surgical intervention

BRIAN BLADES

Laipply T C Arch Path 93: 9 33 1945

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## THE BOOK SHELF

### JOHN COAKLEY LETTSOM AND HIS LITERARY FRIENDS

JOSIAH C TRENT M.D. F.R.C.S. Durham, North Carolina

On Wednesday May 15, 1776 James Boswell, busy with his microscopic examination of the opinions, character and behavior of the great Dr Johnson subjected his hero to a test. He arranged for a dinner at the house of Edward and Charles Dilly the booksellers. The other guests, not named to Johnson until he met them in Dilly's drawing room, included the radical John Wilkes, regarded by Johnson as not only for hanging, and Arthur Lee who to quote Boswell, "could not but be very obnoxious to Johnson for he was not only a patriot but an American." On being introduced into this uncongenial company Johnson gave vent to a few resentful "tut, tut, tut's," stepped aside from the group, and fixed his attention on a book he had taken up. With the call to dinner he rejoined the others, his composure restored. Wilkes's assiduity in helping him to choose bits of real changed composure into complacency and Johnson was soon in a mood to enjoy fully both dinner and table talk.

Boswell's account of this momentous occasion is chiefly concerned with the conversation of Johnson, Wilkes, Lee, and himself on such subjects as actors, poetry, and Scotland. The other guests present are mentioned only once "Mr (now Sir John) Miller Dr Lettsom and Mr Slater the druggist." With two of these gentlemen we are no more concerned than Boswell was, but Dr Lettsom deserves a closer examination.

Since 1770, John Coakley Lettsom had practiced medicine in London, with notable success. A Quaker born in the West Indies in 1744 he had been educated in a school near Lancaster then apprenticed for five years to a surgeon and apothecary in Settle, Yorkshire. His medical education had been completed by a year in the London hospitals, and, after six months of practice

in the West Indies to recruit his finances, by courses of study at Edinburgh and Leyden. He graduated M.D. at the latter university on June 20, 1769 with a thesis on tea. The young author suggests in this essay with the authority possible only to the medical student, that the universal use of tea has been responsible over several generations, for a noticeable decrease in the strength of the human constitution and for a consequent decrease in the frequency of violent fevers.

"This change and diminution of inflammatory diseases, however brought about, tho' it may free us from the attacks of many violent symptoms, is nevertheless productive of more pernicious effects, and more troublesome complaints, than the former, both with respect to number & degree of violence. A multitude of Disorders, & complicated ailments have succeeded, to which our ancestors were strangers. Our Bodies be lost that strength, & acquire in our ancestors, and become enervated, and liable to more diseases; and those depending upon relaxation and debility are now endemic. Hence that frequency of Hystricks in both Sexes, the Hypochondriacs, Palsy, Cachecty Dropsy &c.

"It is thus that what has been advanced by so many means conclude that Tea is the sole cause of all these complaints for luxury of every kind, to please the palate, has almost every where extended its influence it even entered our Kitchens and Cellars, and contributed its share in the production of these diseases with much labor. Under this head the frequent use of spirituous liquors stands foremost.

But why does this custom so frequently occur? The answer is obvious. The economy of the whole frame rendered weak & feeble by the constant and daily use of drinking Tea, and being sensible of debility and oppression, leads the trembling hand, to seek temporary relief, in some cordial, in order to refresh and excite again the system. Hence such almost by necessity fall into the habit of Intemperance, and what Baccus may now-a-days be represented under Petticoats."

After his graduation Lettsom visited Paris and the great spas of Europe, then returned to London, the theater of his ambitions. In 1770 he

J. C. Lettsom. *Dissertatio Inauguralis Medica, de usu Observationum ad Virus Theriacale*, Leyden, 1769, pp. 35. The English version quoted is from a manuscript translation signed "W.C.", which is author's collection.

From the Department of Surgery, Division of Thoracic Surgery, Duke University School of Medicine and Hospital.

For Boswell's account of the occasion, see his *Life of Samuel Johnson*, LL. D. II, 82-83. London, 1791.



John Cockley Lettsom (standing center) is shown presenting to the Medical Society of London in 1788 the deeds of No. 3 Bolt Court, a house which was used by the Society for its meetings and library until 1850. Painted by Samuel Medley in 1800, the picture shows also Dr. James Sims, wearing a Napoleonic hat, and Dr. Edward Jenner standing at Sims's left.

married the daughter of a wealthy tin-plate manufacturer became a licentiate of the Royal College of Physicians and began the practice of medicine. His success in practice was almost immediate as a result partly of the recommendation of his patron the famous Dr. John Fothergill partly of his own untiring efforts. He soon became one of the first physicians of London possessed of a town residence on Basinghall Street and ten miles away a country estate Grove Hill in Camberwell where his guests could choose among the entertainments offered by an extensive library, an excellent cellar, mineralogical and numismatic collections, a botanic garden with opulent greenhouses, a complete set of apparatus for experiments in natural history in addition to a bowling green.

Lettsom's opinion of his own profession was a curious mixture of idealism and sentiment. He aspired to be far more than a healer of the sick; he thought the physician should be a consolator of the bereaved as well a guardian angel sent by Providence to support them in their misery; he should be a helper of the poor and a prime mover in all philanthropic endeavors; he should be not only a professional in medicine but also an amateur of all the sciences; he should be a gentleman and a scholar versed in history, literature—both ancient and modern—music and the other arts. In all these directions Lettsom sought to develop himself. Medicine and humanitarian pursuits demanded most of his time; the small remainder he devoted to scientific and literary studies or to pleasant recreations with his chosen friends.



Prince of Abyssinia, was perhaps his own picture and it inculcates apathy to the world rather than happiness in it. Upon the whole, he seems not to have been a happy man; his religion was rigid rather than social, and his mind warped by system, rather than humanized by virtue and truth. But who is perfect? <sup>7</sup>

Cuming's answer leaves no question as to his conviction of Johnson's imperfections

I have repeatedly read over your Character of Dr Johnson. I shall read it again and again the features appear to be so accurately drawn with such a due proportion of light and shade the praises given to his virtues and abilities so justly balanced by your candid acknowledgment of his failings and weaknesses, that I can better depend upon its being a just resemblance than on any other representation that books or conversation have ever given me of him. But yet, my friend—say, yet—though I ever admired the great extent of his literary abilities and few perhaps possessed greater I could never consider him as an *amiable* character. Conscious of the superior dimensions of his own abilities, he treated others who perhaps, were his inferiors, with a fastidious contempt. He always seemed to me sententious, oracular, and dogmatical in his assertions stiff in opinion and hardly ever adopting that of others, however clear in opposition to his own, narrow and illiberal in his sentiments, respecting those who differed from him in religious or political tenets, and of those who had not the felicity to be born within the jurisdiction of England. His *Dictionary* it must be confessed has singular merit, and exhibits a great extent of reading and judgment.

Cuming completes his letter by pointing out a few flaws in the dictionary. To this barrage of criticism Lettson replied with an account of the dinner at Dilly's.

In social company, when he unbended from critical austerity, Johnson afforded the finest dessert to a rational repast. I once dined with him, Wilkes, Boswell, and Lee the American,—what a group! It was ungrateful, said Lee, 'for the Scotch, who, when emigrants, always found an asylum in America, to be the most violent opponents to American independence and to oppose their benefactors in the cabinet and in the field.' The obligation replied Boswell, 'was not so considerable, when it is understood that the Americans sent the Scotch emigrants to Cape Fear, and such like barren regions.' I think, said Johnson 'they acted like philosophers. Why? Boswell inquired. Because, added Johnson 'if you turn a starved cow into clover it will soon kill itself by the sudden transition and if the Scotch, famished in their own country, had been placed in the more fruitful parts of America, they would have burst by a bellyful, like the cattle in clover. Nobody enjoyed a laugh at the expense of the Scotch more than Boswell, at least when it came from Johnson and the latter appeared to do it in play but his play was as rough as that of a bear and you felt fearful of coming within the embraces of so fierce an animal. <sup>8</sup>

In answer Cuming drew an invidious comparison between the gentle and courteous manner of Dr John Campbell author of the *Survey of Brit* and that of Dr Johnson then went on with anecdotes of his own acquaintance with the illus-

trious Bishop Warburton. He could not conclude without another blow at Johnson

Notwithstanding all that you and others have said I must still think this said Dr Johnson had a *ferine* malevolence in his disposition with a very narrow contracted heart, from the dislike he manifested for those who were not born in the same island. Can anything be more unworthy of a philosopher whose mind ought to be divested of all prejudice? <sup>9</sup>

At this point Lettson seems to have abandoned the futile defense he has no more to say about Dr Johnson. But Cuming raised the subject again in May 1786

Dr Johnson and his biographers have employed the press, and been the subject of most conversations ever since he died. That poor man's fate has been singular beyond precedent in the annals of literature. While he lived he was considered as an excellent classical scholar as the author of several works, some of approved merit, and others of an inferior character but known as a man of a disposition sour and *introditable*, yet still he might have been handed down to posterity as a tolerable mixt character in some points respectable but no sooner was the poor man laid in his grave, than four or five of his most intimate friends took it into their heads, that he merited nothing less than deification and to work they went with a determined resolution of elevating his character beyond that of any that has ever dignified or adorned human nature. But so peculiarly unfortunate have they been in their endeavors, that every effort they made to elevate has operated in a retrograde direction and these united efforts have dragged him down below mediocrity. His learning appears to be no ways superior to that of many others whose names have been less known. His political opinions were a jargon of nonsense, his religion a system of gloomy, weak, and slavish superstition. His temper arrogant, contemptuous, and unsocial his disposition vain conceited, sour and often malevolent. Upon the whole, he was a most unamiable being and most of these failings the intemperate and injudicious zeal of his best friends has by a strange fatality brought to light. Boswell's and Poxon's works are wonderfully trifling and inconsistent. I am sorry to hear that Boswell is deaf to every remonstrance, and fear that this affair will end fatally for his intellects. <sup>10</sup>

The biographers suffer even more severely in a letter which Cuming wrote on June 6 1787. He has been reading Sir John Hawkins life of Johnson and finds that the hero 'loses ground in (his) estimation by every page that (he) peruse(s) and that Johnson's whole life seems to be a great aggregate of inconsistency want of judgment, strong prejudices, gloomy superstition supreme arrogance, and gross rudeness of manners. <sup>11</sup> And the biographers have brought all this to light

His character may be compared to Caesar's mangled robe, when displayed by Marc Antony to the Roman people, after the assassination—'Look! in this place ran Ptoleus's (Cassius) dagger! through this the well beloved Boswell (Brutus) stabbed! See! what a rent the envious Hawkins

Ibid., I, Corr 77-78.  
Ibid., I, Corr 82-83.  
Ibid., I, Corr 84-85.

Ibid., I, Corr 91-92.  
Ibid., I, Corr 95-97.  
Ibid., I, Corr 24.



(Cass) made. And he is still doomed to further indignities by the publication of his Life threatened by Boswell.

It is not recorded that Lettson came to the defense of Boswell a fact which seems surprising when it is remembered that the biographer was a closer friend of his than ever Johnson was. They had probably met long before the Johnson-Wilkes dinner at one of the frequent parties that gathered at the Dilly house during the early seventies, and they must have met often during Boswell's many stays in London thereafter. Both men were present at a dinner given by Charles Dilly on October 23, 1787, when Boswell "was very low and injudiciously had recourse to too much wine to raise (his) spirits." They met again at Dilly's on May 9, 1790 and on July 20, when Boswell again "drank rather too liberally." John Nichols informs us that on occasions when Charles Dilly found it necessary to leave his guests earlier than he wished he deputed the pleasure of entertaining them to Boswell who sometimes, in that capacity, has tried the strength of the *oldest binn*. "Whether or not Lettson was ever present on such an occasion he had ample opportunity to observe Boswell's convivial indulgences, for on June 18, 1791 he found it desirable to address to his Scottish friend a serious warning.

When I acknowledge that ever since I had the pleasure of thy acquaintance I have felt singular esteem for thee I only express a sentiment which every other person must feel if placed in the same situation. The generosity and candour the openness of thy heart combine to acquire and to secure the attachment of every liberal mind. This attachment I presume to claim. It is this that compels me to risk thy future friendship, in embracing the freedom which it inspires.

I have, my friend, had some occasion of leaving thee in the most interesting situations, when thy whole soul has been poured out in social enjoyment, I might have said ecstasy and in no spot of less earnest thou pipest more exulting, for those will love thee most who see most of thy heart. But in these scenes of pleasure which I have cordially enjoyed, sometimes sighs of solicitude has burst upon me lest by any unguarded excitement of such conviviality bodily constitution may be undermined, and that life thereby shortened which every man of refinement and true sociality must wish long, very long preserved.

"I have observed, not merely a too frequent use of the glass, but that mixture of Baccus which, as a professional man, I can add, tends to injure the best human fabric. I will add further that ample experience authorizes, that by baccus means the spirit are exhilarated beyond the chart medium of nature the alternation of mental languor will result so that the depression is great in proportion to the degree of foreign excitement.

"Thy most escholden me thus to recall to sober reflection to chasten and to moderate the fascinating influence of social pleasures, either too frequently repeated or too long extended. I feel that the first place the emotions of friendship which I cannot repress, and in the next, the intrinsic solid sense of me I am proud to call my friend, these equally impel me to risk his censure whilst the latter encourages me to subscribe in self his sincerely

J. C. Lettson.

This letter Boswell apparently took in good part as he had taken similar advice from Johnson years before. He did not, of course, pay much heed to Lettson's warning. In a letter to Lettson written six months later he partly explains his state of depression by admitting that he has not followed Lettson's friendly recommendations as to regimen. *Spero meliora*. "Certainly Lettson took no measures to remove temptation from his friend's way. Boswell dined with him on November 6, 1793 and describes the evening thus

At Dr Lettson's as mercurius Company several of those whom I had seen at his house in Camberwell. We sat late and drank great deal of the St John Peter late Consul at Ostend, carried me in coach with his Lady to their lodgings in Leicester Square, and made me go up and take glass of Baccus and then was so kind as to proceed with me in the coach to my own door and see me safely home I being good deal intoxicated."

Boswell made one of the party at Grove Hill on several occasions. his journal contains a pleasant record of one visit on August 21, 1790

At Dilly's I dined with Dr Lettson this charming villa at Camberwell Grove. At an old gentleman of Alverton who had lived long at St. John's and had been 30 years without being in Britain, dined there as did Dr. Sims, the Irish City Physician. We played 3 bowls both before and after dinner, the gentlemen of Camberwell, whose names I forget, had joined us. I relished the amusement much, and as conscious of being carried along the stream of life with no steady direction but without painful, for which I am so framed as to think I may compound."

The joys of the villa are more fully and fairly presented in an Horatian Ode to Charles Dilly, which Boswell composed in honor of Grove Hill and its master:

My cordial Friend, still prompt to lend  
Your cash when I have need of—  
We both must bear our load of care—  
At least talk and read on't

Yet are we gay in every day,  
Not minding here the joke He  
On Saturday at bowls we play  
At Camberwell with COARLEY

Ibid I Cor. 14, 35.  
Private Papers of James Boswell from Malahide Castle, XVII, 40. Privately printed, 93.  
Ibid XVIII, 33, 83.  
John Nichols. Literary Anecdotes of the Eighteenth Century III, 92. London, 1848, 83.

Pettigrew op. cit II 284, 285.  
Ibid 1, 286.  
Private Papers of James Boswell, XVIII, 1.  
Ibid XVIII, 90.

Methinks you laugh to hear but half  
The name of Dr LETTSOM  
From him of good—talk, liquors food—  
His guests will always get some

And guest has he in ev'ry degree  
Of decent estimation  
His liberal mind holds all mankind  
As an extended Nation.

LETTSOM we view a Quaker true  
'Tis clear he's so in one sense  
His Spirit strong and ever young  
Refutes pert PRIESTLEY'S nonsense

In Fossils he is deep we see  
Nor knows Beasts, Fishes, Birds all  
With Plants not few some from Pellew  
And wondrous *Mangel* II wrel.

West India breed, warm heart, cool head,  
The City's first Physician  
By schemes *humane* Want, Sickness Pain,  
To aid is his ambition.

From terrace high he feasts his eye  
When practice grants a furlough  
And, while it roves o'er Dulwich groves  
Looks down—even upon THERLON<sup>72</sup>

Fortunately Lettsom's literary acquaintance included one who was a better poet than Boswell though his name is now nearly forgotten. John Scott of Amwell the Quaker poet who won Dr Johnson's difficult affections, was long Lettsom's friend and apparently his literary adviser as well.<sup>73</sup> Scott's verses on Grove Hill take up with Boswell's closing note—the striking view 150 miles in circumference, which the site of Grove Hill afforded—then Scott turns to Lettsom himself

That business with fatiguing cares  
For this delightful seat of thine  
Such scanty store of moments spares  
Sa friend, shall I for thee repine  
Were it the commerce of the main,  
Or culture of the teeming plain,  
From blame or pity I should scarce refrain

But, oh, to alleviate human woes  
To banish Sickness, banish Pain  
To give the sleepless eye repose,  
The nerveless arm its strength to gain  
From Parents' eyes to dry the tear  
The Wife's distrestful thought to cheer  
And end the Husband and the Lover's fear

Where Want sits pining, faint and ill,  
To lend thy kind unpurchas'd aid,  
And hear the exertions of thy skill  
With many a grateful blessing paid—  
'Tis luxury to the feeling heart,  
Beyond what social hours impart  
Or Nature's bounteous scenes, or curious works of Art<sup>74</sup>

John Nichols, *Illustrations of the Literary History of the Eighteenth Century*, II, 661, 665 n. London, 1877, 753.  
Pettigrew op. cit., II, 352.  
John Scott, *Eulogy on Grove-Hill*, *Gentleman's Magazine*, LXX (August, 1795) 653.

The estate was celebrated in still another set of verses by the oriental scholar and historian, Thomas Maurice. A clergyman Maurice was a voluminous writer and one of the first to popularize the knowledge of the history and religions of the East. He wrote and published many poems, one of which Lord Byron scathingly described as the petrifications of a plodding brain. His rapturous poem on Grove Hill first describes Lettsom the physician, then Lettsom the botanist

Not onl' man's frail race thy skill befriends,  
T' vegetable life thy skill extends<sup>75</sup>

A tour of the Grove Hill botanic garden library and museum follows couched in the peculiarly maddening roundabout diction so popular with the worst eighteenth-century poets. The account of the library has some interest beyond its style

Science then has fix'd her favourite seat,  
There cherish'd Genius finds a safe retreat  
There honour'd and renown'd through ev'ry age  
The mighty fathers of the classic page  
Who wak'd, in Greece or Rome, the soul of song  
Or roll'd the tide of eloquence along  
Assembled in their deathless works appear  
And seem to charm again the ravish'd ear  
There too each great and venerated name  
Enroll'd upon the page of modern fame  
Sages, whose daring minds have nobly soar'd  
And wide the spacious vault of Heav'n explor'd  
Or darting downward, pierc'd the central gloom,  
Where burning gems the boundless shade illumine  
And mark'd great Nature in the secret mine  
With chemic power the glowing ore refine  
Patriots who proudly prodigal of blood  
The rage of fercest tyrants have withstood  
And statesmen, of unspotted honour prov'd,  
By freedom cherish'd and by Britons lov'd  
An awful throng in sculptur'd marble frown  
And fire the soul to deeds of high renown<sup>76</sup>

A few words on that library at Grove Hill will not be out of place and will serve to clarify the stilted phrases of Mr Maurice. It was a splendid collection ample in scope but particularly rich in medical and natural history. The many pieces of value included an unpublished letter of Hippocrates once the possession of Askew. Lettsom acquired it at a sale for ten shillings and sixpence, his agent Dr Sims having let the other bidders know by whom it was wanted.<sup>77</sup> Another notable curiosity was a seven volume work by Jacob Christine Schaffers in which the leaves of the volumes were formed of vegetable and other substances. The classics were represented in a collection of choice editions gathered by the printer

<sup>72</sup> Thomas Maurice, "To John Coakley Lettsom, M.D. on the Improvements at his Villa of Grove-Hill," *Gentleman's Magazine*, LXX (August, 1795) 656.

<sup>73</sup> *Ibid.*, p. 650.

<sup>74</sup> Pettigrew op. cit., I, 22-23.

William Baker and purchased by Lettsom after Baker's death.

The library bookcases were divided into sixteen compartments, each topped by a bust of some personage appropriate to the subjects of the books beneath him.<sup>27</sup> Thus John Wesley presided over Tracts and Miscellanies. Addison over Reviews. Pott over Surgery and Chemistry. Stukeley over Antiquities and Medals. Hogarth over Prints and Maps. Newton topped Arts and Sciences. Locke Divinity and Law. Bacon, Dictionaries and Classics. Voltaire History and Biography. Milton Poetry. Raleigh, Voyages and Geography. Boyle and Franklin Natural History. Sydenham Medicine. Fothergill Medicine and Botany. Mead, Hortus Siccus and manuscripts.

Lettsom found it necessary to dispose of Grove Hill some years before his death, and a part of his library, which was too large for his town residence, had also to be sold. It was auctioned off by Leigh and Sotheby, during the week of March 26, 1811. At his death in 1814, Lettsom still possessed a library of over 12,000 volumes, which was sold by the same dealers two years later.<sup>28</sup>

Lettsom a many other literary acquaintances can be mentioned only briefly. He was for decades the friend and physician of John Nichols, editor of the *Gentleman's Magazine*, who described Lettsom as one who gladdened as well as lengthened life. Charles Dilly the bookseller was Lettsom's publisher and devoted friend throughout their mature lives, and at his hospitable Lettsom met authors and scholars by the score. On his death Dilly left the physician a legacy of five hundred pounds. Lettsom's varied interests brought him the acquaintance of many philanthropists including John Howard and John Nield, of the botanist William Curtis, the naturalist Peter Collinson, the mythologist Jacob Bryant. He corresponded widely with men of letters and science in other countries, with Rush, Franklin, and Waterhouse in America. Zimmermann in Hanover and William Thornton in the West Indies—the last named was designer not only of the Capitol building at Washington but also of a universal alphabet calculated to solve all linguistic difficulties.

Lettsom held yet another place in the literary history of his time: he was always a generous and helpful patron to men of letters. As Pettigrew

writes "In him the sons of genius were sure to find a friend."<sup>29</sup> One of the writers who owed much to Lettsom's aid has been mentioned—William Curtis, the botanist. A result of Lettsom's awareness of the general neediness of the writing clan appears among his philanthropic essays, a paper entitled "Hints for Establishing a Society for Promoting Useful Literature."<sup>30</sup> The proposed society would give rewards, pecuniary or honorary, to deserving authors, would establish prizes, care for the widows and orphans of authors, and erect monuments to deceased genius. This "hint" of Lettsom's is of particular interest for while itself ineffectual, it preceded by ten years the establishment of the Literary Fund.

Many institutions of learning, also owe a debt to Lettsom. From his American friends in particular he received many appeals on behalf of colleges and libraries. Dr. Rush wrote for Dickinson College in 1785:

I know the pleasure you take in doing good. I know our zeal in promoting knowledge, and hundreds testify to your partiality to the American States. Will you give me leave to solicit your friendship to our College in begging a few books from you. Friends for our library, the offerings of their studies, will be very acceptable in our illiterate western country. The number of the stalls in the streets of London, which are sold by night, could make us truly rich.<sup>31</sup>

Waterhouse sponsored Harvard. James Braddon presented the needs of the college his father. To each Lettsom sent letters. In 1800 the managers of the Peil Hospital asked Lettsom's aid in purchase for their library, he not only supplied advice, but also sent volumes from his library.<sup>32</sup>

John Cookley Lettsom was convinced that the physician should be "a scholar versed in history, literature, and the other arts, and shaped his life accordingly." Today in our struggle for the science, particularly as it applies to our fields, we as physicians too often neglect humanities, become narrow and limited in and fail to assume that leadership in the arts which is our heritage. Certainly one of the greatest physicians of the eighteenth century as a cordial friend of literary men and generous patron of learned institutions also a place, however small, in the annals of literature.

<sup>27</sup> Pettigrew, op. cit. I, 47.

<sup>28</sup> First published in the *Gentleman's*

*Magazine*, op. cit. II, 48.

<sup>29</sup> Pettigrew, op. cit. I, 47.

<sup>30</sup> Catalogue of the Medical Library

of the University of Pennsylvania, 1859, pp. vii-viii.

<sup>31</sup> Ibid. I, 48. 60.  
Nichols' Illustrations of the Literary History of the Eighteenth Century II, 663a.

## REVIEWS OF NEW BOOKS

THE book *A Textbook of Gynaecological Surgery*<sup>1</sup> is one that all gynecologists and surgeons should have in their library. It is both interesting and advantageous to have available a book which presents the English point of view and methods so excellently. The radical abdominal operation (Wertheim) for carcinoma of the cervix is thoroughly discussed. These authors have had a tremendous experience with this procedure. Their thinking on the subject is set forth clearly and all aspects are discussed. The current arguments concerning subtotal and total hysterectomies and vaginal versus abdominal hysterectomies are considered and their opinions are given.

Their conservative attitude toward removal of the ovaries is to be commended and their statements are well worth reading.

The chapters on Remote Results of Gynaecological Operations and Postoperative Complications are extremely interesting.

The dangers inherent in the performance of each surgical procedure are listed and discussed. This makes the book a handy reference.

The infusion and transfusion procedures differ quite widely from those carried out in America. On the basis of scientific knowledge our practices seem more fundamentally sound.

While the changes and additions in this edition are not numerous, the complete thoroughness of the book makes it valuable.

JOHN L. BARBER.

THE volume entitled *A History of the Heart and Circulation*<sup>2</sup> by Dr. Willis and Dr. Dry follows the general principle that history is composed of biographies. Thus throughout the work page after page introduces a new character usually with his portrait and an interesting statement of his contribution. In the first part of the book this biographical material is grouped into chronological epochs ending with the first quarter of the twentieth century. Then a very interesting series of special biographies is presented beginning with Hippocrates and ending with modern authorities such as Wenckebach, Mackenzie, Osler and Lewis.

There is in conclusion a section presented according to subjects such as arrhythmia, intracardiac circulation, surgery of the heart and blood vessels and so forth. Each chapter and division is accompanied by numerous references so that the volume although

relatively small, is a starting point for any extensive and thorough review.

One may therefore urge that this book on the history of the heart be read for interest and education and that it may also be used as an important secondary source.

PAUL STARR.

THE second edition of *Intracranial Tumors*<sup>3</sup> is a classical discussion of intracranial neoplasms written by Percival Bailey, a distinguished neuropathologist and neurosurgeon. It continues the tradition of the first edition published in 1933. Very few changes in content are readily apparent, perhaps indicating the stagnation of neurosurgical effort in the control or understanding of neoplastic growth during these 15 intervening years. The author states that the main thesis of the volume remains unchanged but errors have been corrected and recent advances in knowledge inserted. Sixteen plates depicting gross changes in the x-ray study of the skull, brain and cerebral vascular system during tumor development have been appended to the text. Only 33 of the 521 references represent material published since 1941.

The method of presentation of an admittedly difficult subject should be uniquely valuable to the student of neurology. The text may be described as a refined and readable version of lectures presented to students. It may be read with profit by any specialist in this field since it reveals one expression of neuropathological thought in a certain time period that may shortly be of historical interest alone.

The volume opens with a short discussion of the problem of tumors in general followed by two chapters devoted to the structure of the cranium and the elements of neurophysiology. Thirteen discrete cerebral tumors or tumors involving specific tissues such as connective tissue are then presented in separate chapters and are worthwhile reading for the student indeed. Each tumor or group of tumors is identified by brief historical notes. Several case reports are then detailed followed by a discussion of the gross and microscopic structure of the neoplasm. These pathologic features are illustrated by black and white drawings that do not fairly represent the author's vast knowledge of this phase of neurosurgery. Even if the microscopical drawings are intelligible to the student they must at least discourage any further pursuit of the subject.

The main substance of each chapter is found in the authors' often lengthy but always lucid discussion of clinical neurological syndromes. These may be considered as superb lessons in neuroanatomy, neurophysiology and neurology pointed and

*INTRACRANIAL TUMORS.* By Percival Bailey. 2nd ed. Springfield: Charles C. Thomas, 1948.

<sup>1</sup> *TEXTBOOK OF GYNAECOLOGICAL SURGERY.* By Victor Bonney, M.S., M.D., B.Sc. (Lond.), F.R.C.S. (Eng.) Hon. F.R.C.S., Hon. F.R.C.O.G., M.R.C.P. (Lond.), and Sir Conway Berkeley, M.A., M.C., M.D. (Camb.), F.R.C.P. (Lond.), F.R.C.S. (Eng.), M.M.S.A. (Ireland), F.R.C.O.G. 5th ed. New York: Paul B. Hoeber Inc., 1948.

<sup>2</sup> *A HISTORY OF THE HEART AND THE CIRCULATION.* By Frederick A. Willis, M.D., M.Sc. in Med., and Thomas J. Dry, M.A., M.B., Ch.B., M.D. in Med. Philadelphia & London: W. B. Saunders Co., 1948.

enlivened by the preceding case histories and the neuropathological data. These are "sharply defined syndromes characteristic of the various pathological types of tumors in different locations in the intra cranial cavity" and nowhere in neurological literature have they been better presented.

The eighteenth chapter has to do with the matter of general diagnosis. It is marked by the sound but often disregarded, advice to the young physician to learn to use the ophthalmoscope as well as he does the stethoscope, by the author's aversion to the use of ventriculography and by failure to mention electroencephalography as a valuable adjunct in tumor diagnosis. The next chapter touches upon the various facets of differential diagnosis, a large subject in itself which the author presents in an effort to stimulate the student in his ancillary reading. More modern references, such as those of Ingraham in subdural hematomas in infants and those of Dandy in congenital cerebral aneurysm, for instance would aid in this worthwhile project.

The twentieth, and last chapter recounts the author's principles of treatment of intracranial tumors. Few neurosurgeons agree with one another in terms of neurosurgical technique, but there will be some who will dispute any use of intracapsular removal of acoustic neurinomas or the advice to disregard the temporal intradural approach to pituitary tumors. Some neurosurgeons will use oxygen instead of air for ventriculography and will mention intratracheal ether as a good anesthetic agent. They will be happy to use the electrocautery in bleeding from brain tissue and gelatin sponge and hemostatic synthetic bone wax and tantalum clips and begin craniotomies with a transfusion rather than end them with such resuscitation methods.

In spite of these minor differences of opinion and the use of fourth decade techniques their results will be little different from those that are graphically and dispassionately revealed by the author. In this book the great contribution to brain surgery of neurology and tissue pathology are brilliantly disclosed by a master in these fields. Some part of the technical achievements of neurosurgery is at most suggested. The appalling impasse in which the surgery of cerebral gliomas now finds itself is all too obvious. The hope for the future does not lie in the direction of increasing our knowledge and acumen so that we can foretell before operation—the nature of the tumor to be attacked as well as its location." This hope has been in large part achieved. This volume can act as a standard springboard into uncharted waters whatever they may be but its philosophy of thought can produce nothing more. BARBARA WOODMILL.

THE monograph *Osteosynthesis with a Long Intramedullary Metal Pin (Küntschers Method)* by Emil Jan Möllys although not as elaborate as some other presentations, notably Böhlers does add

\*OSTEOSYNTHESIS WITH A LONG INTRAMEDULLARY METAL PIN (Küntschers Method). By Emil Jan Möllys. Utrecht Kemink & Zoon N.V. 1941.

definitely to the literature on medullary nailing and is a work which can be read with profit by everyone interested in fractures. To some extent the method has been accepted in this country for the treatment of certain shaft fractures, and the opinion of a surgeon like Möllys who reports after an experience with over 350 cases must be considered as definitely authoritative. Möllys believes that "this method is a great advance in the field of fracture surgery" and even one with little or no experience with the medullary nail must agree with him after studying his essay.

The work discusses briefly at first the object of all fracture treatment and then gives more in detail the essentials of the method with separate headings for (a) reaction of the bone marrow, (b) possibility of fat embolism, (c) chance of infection, (d) general reaction to the presence of the metal pin, and (e) influence of the pin on callus formation. Apparently although there are definite temporary changes in the blood picture after introduction of a nail and sometimes until it is removed, no harmful effects have ever been seen and the possibility of fat embolism is no greater than in fractures treated by other methods. Möllys goes into the subjects of the reaction of bone to metal as well as fracture and callus formation at some length. The chapter on the latter subject is well worth reading. He sums up by stating the use of the nail is ideal both in anatomical and functional respect and mentions that Böhler reduced the hospital stay in certain types of femoral fractures from between 240 to 340 days to 45 days with the Küntschers pin. The second half of the monograph gives an excellent but short review of the literature and then discusses in detail the technique of the method as applied by the author. A special table is used and a roentgenologist is always present to guide the nail by means of the fluoroscope and the use of so-called "wringers," which are like large Thomas wrenches, to control the fragments. In open fractures this help is of course unnecessary as the guide wires are introduced at the site of the fracture. Möllys states that the most important thing is reduction of the fracture and that by using his specially constructed table we succeeded in all cases. Then the operation itself is a minor procedure.

Details of 100 cases are given which add to the size of the volume but which add very little to the knowledge of the reader and can be skipped if desired. The bibliography is apparently very complete and can be used by anyone interested not only in the Küntschers method but in fracture healing in general.

The monograph should be available to all surgeons working in large well organized clinics where the method can be applied, but it probably will not be of any practical interest to the average doctor as yet.

WALLACE H. COLE.

IN *The Mechanism of Abdominal Pain* by V. J. Klesella clinical investigations of abdominal pain

\*THE MECHANISM OF ABDOMINAL PAIN. By V. J. Klesella. M.B., Ch.B. (Syd.), F.R.C.S. (Eng.), F.R.A.C.S. Sydney Australasian Medical Publishing Co., Ltd. 1941.

are reported and an extensive bibliography is reviewed. Attention is called to the misconception concerning the absence of afferent fibers in the sympathetic nervous system. The author concludes that a belief in true visceral pain has an inadequate anatomical basis and presents reasons for believing that direct visceral tenderness occurs. No sharp dividing line was found between sensitive and insensitive regions in the abdomen. A neurohumoral basis to replace the neuronal basis for abdominal pain is postulated. The effective stimulus for pain is raised tension within the tissues, due to inflammatory reaction or to powerful muscular contraction, or both. Tenderness in visceral disease is believed primarily and essentially to be that of the diseased visceral tissue; parietal tissues may be secondarily involved. Rigidity is believed probably due to a simple spinal reflex. The varieties of abdominal pain are recorded and the attempt is made to understand them upon the simple basis of direct visceral sensibility.

WALTER H. NADLER

THE little volume *Anatomía funcional del sistema nervioso Vegetativo* by Prieto and Uria approaches the neurovegetative system from a purely functional viewpoint. It is believed that to separate function from morphology is a mistake particularly inasmuch as no significantly new neuromorphologic contribution has been broached in recent times. The book is a compendium of a larger work in preparation on nervous functional anatomy. It presents the important features which have come to light recently and gives a résumé of modern thought on the matter.

Interpretation of the morphologic function of the vegetative nervous system has undergone numerous modifications; the fault of garbled nomenclature. The first chapter attempts to unravel this situation. Afterward such topics as the functional systematization of nuclei associated with peripheral nerves, functional localization of the hypothalamus, cranial parasympathetics, metasympathetics, innervation of the circulatory apparatus and other organs are considered in orderly chapters. The book concludes with an appreciation of vegetative sensibility and numerous unusually clear contrast illustrations make the volume a worthwhile acquisition particularly for the beginning student of neurology.

STEPHEN A. ZITMAN

THE book *Chirurgie moderne de la hanche* appartient de la radiographie de profil by René Charny was not intended to be a comprehensive treatise on hip conditions. The author describes some of the more common arthropathies and their surgical treatment. Vitallium cup arthroplasty is not mentioned and hip fusions are not discussed. Great emphasis is placed on the lateral x ray view of the hip using the Judet

Mathieu technique which apparently is similar to that commonly used in this country under the name of Manfredi. The author points out the x ray findings in different positions of rotation and stresses the fact that the posterior articular margins of the hip in the lateral view are parallel. He discusses congenital dislocation of the hip as seen in the adult, and he distinguishes between subluxation and luxation. In the former osteoarthritis is the rule and invariably develops after the age of 35. On the contrary true luxation does not develop arthritic changes unless treatment was attempted in early childhood. The author supports his view with observations made in operative cases. In subluxation the lateral x ray view reveals that the posterior articular margins are not parallel and the femoral head is slightly displaced anteriorly. When this is recognized early an anterior buttress graft is indicated. The operation is technically difficult but it has the advantage of preventing the development of arthritic changes. When osteoarthritis has already supervened an arthroplasty is the treatment of choice. The author employs fascia lata to cover the femoral head. Vitallium cup arthroplasty is not mentioned.

The author continues with the description of other forms of osteoarthritis and atrophic arthritis pointing out that in these conditions the posterior articular margins of the hip are parallel in the lateral x ray view. He discusses the various operative procedures of neurectomy, drilling and pegging, shelf stabilization, osteotomies, Mathieu's resection, arthroplasty with their indication and their relative value. The latter procedure (which apparently is very similar if not identical with the Whitman operation) is preferred to hip fusion.

In cases of old luxation of the hip the author describes the accepted operative procedures (shelf stabilization, osteotomy) but in limited cases he prefers to do an open reduction, resecting an inverted V shaped segment of bone through the trochanteric region and transplanting the greater trochanter to the shaft of the femur. However, since no end results and other statistical data are mentioned, this procedure cannot be properly evaluated.

In coxa vara, the lateral view shows slight anterior displacement of the head. The author performs an anterior buttress graft and transplants the greater trochanter on the shaft. His results are excellent; however, again no statistical data are furnished.

Although the book is entitled *Modern Surgery of the Hip* the reader will not find in it such commonly accepted procedures as vitallium cup arthroplasty and Britain's arthrodesis. Apparently this was beyond the scope of the book. The text is well illustrated with 512 roentgenograms and tracings and makes interesting reading. C. L. JENNINGS.

THE author of *Venous Thrombosis and Pulmonary Embolism* by Harold Nehrfus has been interested in the subject for many years. This monograph is

BY ROBERT TERRYHOVEN AND FRANK M. ST. ENJOUL. By Harold Nehrfus, M.D. New York, Crane & Patton, 1935.

14. ANATOMÍA FUNCIONAL DEL SISTEMA NERVIOSO VEGETATIVO. By Ramón López Prieto and Francisco García Uria. Valladolid, Trévila & Cía., 1937.

CHIRURGIE MODERNE DE LA HANCHE. Appart de la Radiographie de Profil. By René Charny. Paris, Gaston Doin & Cie, 1934, 1935.

enlivened by the preceding case histories and the neuropathological data. These are sharply defined syndromes characteristic of the various pathological types of tumors in different locations in the intra cranial cavity and nowhere in neurological literature have they been better presented.

The eighteenth chapter has to do with the matter of general diagnosis. It is marked by the sound, but often disregarded advice to the young physician to learn to use the ophthalmoscope as well as he does the stethoscope by the author's aversion to the use of ventriculography and by failure to mention electroencephalography as a valuable adjunct in tumor diagnosis. The next chapter touches upon the various facets of differential diagnosis a large subject in itself which the author presents in an effort to stimulate the student in his ancillary reading. More modern references, such as those of Ingraham in subdural hematomata in infants and those of Dandy in congenital cerebral aneurysm for instance would aid in this worthwhile project.

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January, 1949

**SURGERY**  
**GYNECOLOGY AND OBSTETRICS**  
*Supplement*

**INTERNATIONAL ABSTRACTS  
OF SURGERY**

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based on a study of 88 fatal pulmonary emboli observed in an 11 year period at the Mount Sinai Hospital in New York between 1927 and 1938. All cases have been verified by autopsy and excellent diagrams are used to illustrate the site and extent of pulmonary emboli. There is a critical review of the literature and a new approach for the extraction of pulmonary emboli is described, which, while unsuccessful in this particular case, certainly merits further study and development. This method was first published in 1944 and no other report has followed this attempt.

Obviously the first part of the book was written later than the second. It contains a large number of histories with critical comments and illustrates the changing concepts in the author's mind toward more anticoagulant therapy. While in a controversial field as this lack of agreement is not unusual and invites further progress, one must point to certain discrepancies between the author's statements.

Thus for instance, while he is convinced that major pulmonary emboli, with the exception of a cardiac source, come overwhelmingly from the legs, he presents histories which show that lower abdominal pain (a pelvic thrombus) preceded the closure of the iliofemoral segment. He does not take much stock in the reflex effects of pulmonary emboli and yet describes two perfect examples of minor pulmonary emboli with a patent main pulmonary artery both of which were fatal with symptoms of a shock-like state. He does not mention the increased tendency to clotting

as an important factor in thromboembolic phenomena and yet describes cases in which propagating thrombosis occurred in the contralateral extremity under the customary dosage of heparin. One has the feeling that there is too much reference to part 2 in part 1 of the volume and that logically the first part, written later, should follow and not precede the second one.

With these minor exceptions, however the great merits of this monograph should be stressed. The author advocates an extensive search for flaccid thrombi free or adherent after sectioning the common femoral vein, he states that there is no dependable relationship between the location and extent of the pulmonary embolus and the clinical symptoms he favors more and more to anticoagulant therapy in calf muscle thrombosis and does not believe in ligation of the superficial femoral vein.

The monograph is of interest to all general surgeons as it is a true account of the problems confronting them in their daily practice. Many questions, of course remain unsettled but it is through publications of this sort that an agreement can be reached as to the simple and safe measures to prevent and treat pulmonary embolism. While the presentation is repetitious, this is a provocative book which should be in every surgeon's library. Most refreshingly a detailed study of individual histories is presented in contrast to mass statistics, which often have the musty order of record libraries and seldom add diagnostic refinements. OSMA DE TARENTE

## BOOKS RECEIVED

Books received are acknowledged in this department, and such acknowledgment must be regarded as a sufficient return for the courtesy of the sender. Selections will be made for review in the interests of our readers and as space permits.

**PREGNANCY DIAGNOSIS TESTS: A Review.** By Alfred T. Cowley, B.Sc., M.R.C.V.S., Ph.D. Published by the Commonwealth Bureau of Animal Breeding and Genetics, Edinburgh Dairy Science, Shinfield Animal Health Weybridge, 948.

**ABDOMINAL OPERATIONS.** By Rodney Mainiot, F.R.C.S. (Eng.) 2nd ed. New York: Appleton-Century-Crofts, Inc., 948.

**THE RH BLOOD GROUPS AND THEIR CLINICAL EFFECTS.** By P. L. Molison, A. E. Mount, and R. R. Race. London: His Majesty's Stationery Office, 948.

**MANUAL OF UROLOGY.** By R. M. LeComte, M.D. F.A.C.S. 4th ed. Baltimore: The Williams & Wilkins Co., 948.

**ELEMENTARY ANESTHESIA.** By W. N. Kemp, M.D. C.M. Baltimore: The Williams & Wilkins Co., 948.

**AMERICAN MEDICAL ASSOCIATION INTERNS' MANUAL.** Philadelphia and London: W. B. Saunders Co., 948.

**TECHNIQUE OF MEDICATION.** By Austin Smith, M.D. C.M., M.Sc. Philadelphia, London and Montreal: J. B. Lippincott Co., 948.

**TEXTBOOK ANAESTHETICS.** By R. J. Minnitt, M.D.

(Liverpool) D. A. (R. C. P. & S. Eng.), and John Gilles, M.D., M.B., Ch.B. (Edin.), F.R.C.S. (Edin.), D.A. (Eng.) 7th ed. Baltimore: The Williams & Wilkins Co., 948.

**REPRODUCTION AND SURVIVAL.** By R. Christie Brown, M.B., M.S., F.R.C.S., F.R.C.O.G. London: Edward Arnold and Co., 948.

**AN INTRODUCTION TO SURGERY.** By Rutherford Motson, M.D. F.R.C.S. (Edin.) F.R.C.S. (Eng.), M.A., D.C.L., LL.D. and Charles F. M. Saint, C.B.E., M.D. M.S. F.R.C.S., F.R.A.C.S. 4th ed. Baltimore: The Williams & Wilkins Co., 948.

**THE SURGERY OF ABDOMINAL HERNIA.** By George B. Mahe, M.D., F.R.F.P.S.G. F.R.C.S.E. Baltimore: The Williams & Wilkins Co., 948.

**ACUTE INTESTINAL OBSTRUCTION.** By Rodney Smith, M.S., F.R.C.S. With chapter on radiological diagnosis by Eric Samuel, M.D. F.R.C.S. F.F.R. D.M.R.E. Foreword by Rupert Vaughan Hudson, F.R.C.S. Baltimore: The Williams & Wilkins Co., 948.

**BACTERIAL AND MYCOTIC INFECTIONS OF MAN.** Edited by René J. Dubos, Ph.D. Philadelphia, London, and Montreal: J. B. Lippincott Co., 948.

**THE PRACTITIONER TEXTBOOK. The Practice of Endocrinology.** Edited by Raymond Greene, M.A., D.M., M.R.C.P. London: Eyre & Spottiswoode Ltd., 948.

**EDUCATION FOR PROFESSIONAL RESPONSIBILITY.** Pittsburgh: Carnegie Press, 948.

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Theories of the Etiology of Congenital Deformities. WILLIAM S. KISKADDEN, M.D., F.A.C.S.  
A. M. SCHECHTMAN, Ph.D., and CLAYTON BROCK, M.D. Los Angeles, California

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the impression that the mother's food was even remotely a causative factor of malformations of the face and jaw. Recently Josef Warkany of the University of Cincinnati isolated and proved riboflavin to be the necessary ingredient in the prevention of malformations in mice which supports the contentions of those who blame the lack of certain vitamins. It has been shown that occasionally calcium retention is below normal. Syphilis sometimes plays a part. Cretinism, dwarfism, gigantism and infantilism have been accounted for on a glandular basis. Alcohol although long suspected as a factor has experimentally been found to have no effect upon the production of congenital deformities in the embryo of the laboratory animal. X-rays and contraceptives have been reported as etiological factors with associated substantiated case reports.

#### HEREDITY AND GENETIC EVIDENCE

Medical records are replete with histories and family trees showing the definite hereditary tendency of certain deformities. Hemophilia, allergy, albinism, many skin dystrophies, and other instances of hereditary influences are examples.

Hereditary characteristics are understood as being those characteristics, and physical or mental traits, which are present in parents or remote ancestors, and reappear among descendants in succeeding generations. This occurs by the fusion of gametes, or male (sperm) and female (ova) cells. The germ cells, or gametes, contain particular hereditary factors called genes which exert their action in determining future hereditary physical or mental characteristics.

To satisfy those advocates of environmental influence, it is admitted that any one individual personality or phenotype is a composite of internal, or genetic, and external, or environmental influences. An example of this is the measurement of school children in Oslo, Sweden, where it was found that in 1920 4,000 children were born and in 1933 2,100. Examination of these children and a comparison of these two groups showed that the average gain in weight in 1933 was 3.28 kilograms and in height, 3.89 centimeters. In comparing 1920 with 1933 it was shown that environment, due to smaller families, was undoubtedly the cause.

Geneticists recognize three groups of inherited defects: (1) the group in which the abnormality may occur in one or more sibs, but less often in their children or parents, the recessive; (2) the group in which the deformity is transmitted by direct descent from affected members of a family to some of their children who in turn transmit it, the dominant; and (3) the group in which the ab-

normality is transmitted by normal females and only affects males of the family the sex-linked.

The chance of inheriting an anomaly through the mating of an individual with a dominant anomaly and another individual either normal or heterozygous is 1 to 1. This chance in the mating of a recessive is 1 to 3. In the case of sex-linked inheritance the relationship is 1 to 1 to 1 to 1: the daughters carrying the anomaly and the sons being affected. It is worthy of note that as man is such a poor breeder and his family history is fragmentary or the size of his family is small the above ratio does not always hold.

Occasionally it may happen that a particular gene will undergo a change called mutation. Should this change occur in the germ tract, then the change will be transmitted to the offspring. These changes have been produced by Morgan and his coworkers and also by Bagg, as noted elsewhere. Hugo deVries (reported by S. M. Titchett) in his experimental work with plants, has demonstrated that abnormal characteristics may appear spontaneously, are transmitted to offspring, and eventually disappear by crossbreeding; this is an example of the mutation theory of congenital abnormality in plant life. Abnormalities exist which can be due either to mutation or environmental modification. This duplication of the effect of a mutation by an environmental modification in an individual has been called "phenocopies" by Goldschmidt.

Morgan, in his Nobel Lecture in 1934, in which he implies a constant activity of genes, and that the character of the individual is determined by genes, asks why all the cells of the body are not exactly alike? What determines that some cells will be muscle, some nerve, and others reproductive cells? It is suggested not only that independent cell differentiation of individual cells takes place, but that an organizer exists between them all, causing cell interaction.

Morgan and his brilliant coworkers have proved that man inherits his characteristics in the same way as animals. The present relationship of genetics to medicine is still more intellectual than practical. In the United States, particularly, the genetic relationship of man is most complex because of the amalgamation of different migrating races. Moreover medical advancement today keeps alive many defective types which in animal life would be automatically eliminated. Morgan believes further that genetics can assist in prognosing future deformities in a family following the presence of one deformity. He disparages the hope of purifying the race by proper breeding, but points out that should certain stigmata appear genetics may

supply and when the diagnosis as to disease or the suitability of marriage arises. Laurence H. Snyder, acting as a medical and consulting geneticist to Ohio State University has been one of the first to bring applied genetics close to clinical medicine.

New and extremely interesting work has been reported by Beadle and his associates. By means of *Neurospora*, an ascomycetous mold, studies have shown that the mutation of a single gene can block the synthesis of an essential cell constituent or prevent the utilization of a normal metabolite. In the human being the condition of alcaptonuria in which the ability to oxidize homogenticyclic acid is lost, differs from the normal by one single recessive gene. The conclusions reached by these investigators are as follows:

The synthesis of essential chemical constituents of living matter is under genetic control.

It seems probable that requirements of higher animals for dietary supplements of vitamins and amino acids are the result of gene mutations which have occurred in the evolution of the species.

It would seem that the primary action of the gene has to do with the synthesis of the enzymes which direct chemical activity in the cell.

In still another study, with *Neurospora*, it was possible to discover and maintain x-ray induced mutant strains characterized by their inability to carry on specific biochemical processes. Three mutant strains were established and in one the ability to synthesize  $B_1$  had been wholly lost. In the second the ability to synthesize the thiazole half of the vitamin  $B_1$  molecule was absent and in the third part, the aminobenzoic acid was not synthesized.

Since mutation may be produced experimentally, Kemp reviewed the conditions which one could reasonably assume might arise from mutation in the human being. It is believed that from 92 to 95 per cent of the genetic mutations are recessive although any given hereditary disease may be recessive, dominant, or intermediate according to the length of time that has passed since the disease-producing gene arose through mutation, the younger ones being recessive and the older ones tending to be more dominant.

Some of the conditions occurring as recessive mutations are hereditary dwarfism, hereditary deaf mutism, Friedreich's ataxia, amaurotic idiocy, hemophilia, and color blindness. Among the dominant mutations are hereditary hemolytic jaundice, Mongolian idiocy, Huntington's chorea, sickle cell anemia, and others.

On the basis of a dominant or recessive disease in the population and the fertility of the parents, it is possible to calculate the mutation rate for the

disease provided the frequency of the disease is constant from one generation to another.

Mutation as a cause of disease is dependent upon the frequency of the disease inheritance and the effective fertility of the patients affected.

#### GLANDULAR EVIDENCE

The inter relationship of the glands of internal secretion is too complex to dwell upon at this time. It is entirely possible that some one or group of hormones may influence the developmental rate and its fluctuations as pointed out by Stockard and Speeman. Mention may be made here of the few definite deformities directly ascribable to hormone influence. Evans gives the anterior pituitary lobe five separate hormones: (1) somatotrophic, (2) gonadotrophic, (3) thyrotrophic, (4) mammatrophic, and (5) interrenotrophic. Congenital deformities occurring under the first are growth hormones—as instanced by dwarfism and the cretinic dwarfisms due to a depressing effect on the anterior pituitary lobe by the thyroid. We are familiar with gigantism and acromegaly which may also be congenital.

Gonadotrophic hormones have been used successfully in treating cryptorchidism. Certainly one might well reason that this condition is caused by a diminution of this hormone during fetal life. Another instance of the possible effect of this hormone in experimental work is shown in the case of the Seabright chickens, the normal males looking like hens but following castration they become cocks in appearance. Moreover removal of the ovary causes the hen to take on the appearance of a cock.

True instances of the effect of the other anterior pituitary hormones and their positive relationship to congenital deformities is lacking. Hypospadias and hermaphroditism are both congenital deformities. They may well be due to sex hormones which cause a mutation of the sex genes. Goldschmidt believes this and has on record 2 cases of intersexual identical twins.

Both hypothyroidism and hyperthyroidism may be found in the infant and instances of their effects on development are readily brought to mind.

In the experimental evidence it was noted that frequently congenital deformities tended to predominate in the male, with an associated left-sided predominance, particularly striking in harelip. In this latter condition Warkany cites Fostyn's conclusion that harelip and cleft palate are inherited as a double recessive trait, one gene being autosomal and the other sex-linked. This should explain the predominance in the male. On

the contrary Bagg and Little noted a variance in that they discovered polydactylism in 61 females and 30 males. Sixty deformities were found on the right side, and 27 on the left. Bagg was unable to account for this distribution but quotes Huber who says that the left side of the body is less completely developed, and cites the overdevelopment and frequency of supernumerary fingers on the right side. In contrast, his mice showed club feet in 159 males and 131 females, the condition predominating on the left side (279, left, 205 right). Murphy found that the relationship between male and female was equal in his series however J. S. Davis and German state that the literature on syndactylism shows a predominance of males, and in their own particular series of 50, the males made up 68 per cent of the total. Davis also states that congenital clefts of the lip and palate show a 70 per cent predominance in the males.

Birkenfeld's 385 cases of harelip and cleft palate are classified in Table 1.

Here, again the predominance of male over female and left-sided over right-sided involvement is striking.

Cockayne offers as a solution the presence of a dominating inhibiting gene in the x-chromosome which results in the excess of males. However following this hypothesis, analysis of several pedigrees of psoriasis, epidermolysis bullosa simplex, and angioneurotic edema shows exceptions that are incompatible with such a theory. He suggests that if one assumed that the presence of a sex linked recessive lethal gene caused the preponderance of males, then, at least, a working hypothesis would be afforded for such a preponderance.

# EMBRYOLOGY

The problems of defective development, taken as a whole, have been placed in a state of transition by recent work of the school of experimental embryologists. This is essentially the result of the demonstration within the last two decades, of the existence of a complex series of causal embryological relationships, commonly referred to as "inductions." The ultimate scope and details of these physiological relationships are still largely a matter of future research and to this extent the problems of defective development have been placed in a state of transition, awaiting the further results of embryological research. However enough is known at present to indicate clearly that there can be no sound understanding of development if "inductions" are not brought into the picture.

Much of the basic research in causal embryology (the "Entwicklungsmechanik" of the Germans) has centered around the development of the nervous system. In fact, the clarification of fundamental concepts subsequently applied to other organs has come to a great extent from this field of research largely in the hands of Spemann and his students.

The central fact established by the school of Spemann is the induction of the rudiment (Anlage) of the nervous system, the neural plate. An influence emanates into the future neural plate from the layers of cells just under it, the archenteric roof. Before this influence has been exerted, the rudiment of the nervous system, termed "presumptive neural plate material," has no capacity whatever to form nervous tissue. After the passage of the influence, the ectoderm can develop into parts of the brain or into spinal cord even if removed from the embryo and maintained *in vitro*. The early ectoderm, without the inductive stimulus of the archenteric roof is capable only of proliferation into a mass of cuboidal cells without specific histological characteristics. It obtains its usual differentiative abilities as a result of its contact with mesodermal or endodermal regions of the embryo.

Since the earlier experiments done by Spemann (1918-1924) it has been evident that the archenteric roof induces more than nervous system, and the range of its inductive capacities is now known to be very extensive, including most of the organs of the body. From the ectoderm the organizer has induced various portions of the brain as well as quite complete brains, auditory vesicles, olfactory pits, pigment cells, skin glands, and muscle. Also mesoderm and endoderm react to the stimuli from the archenteric roof although

TABLE 1—HARELIP AND CLEFT PALATE

Degree of cleft formation	No.	Boys	Percent	Girls
Harelip, left	24	27	66.5	17
Harelip, right	5	20	64.6	5
Harelip, bilateral	14	5	25.2	
Total	43	52		22
Cleft of soft palate	22	9	40.9	23
Cleft of soft and hard palate	41	17	40.5	25
Total	63	26		33
Harelip left and cleft palate	10	73	63	44
Harelip right and cleft palate	48	25	62.5	5
Harelip bilateral and cleft palate	76	48	63	26
Total	134	146		75
Grand Total	255	224	64.5	129

not to the remarkable degree found in the ectoderm. This makes clear the reason which prompted Spemann to apply the term 'organizer' to the archenteric roof (and to the upper part of the blastoporal lip which becomes the archenteric roof in subsequent development)

Inductive influences very like those released from the organizer also emanate from dead tissues of many kinds, embryonic and adult. Various tissues from nearly all main animal phyla (e.g. man, rats, cattle, birds, reptiles, fish, worms, molluscs) can induce neural plates and other structures in the early ectoderm (Holtfreter). The tissues may be alive or killed by boiling, desiccating, or centrifuging; they may be macerated and extracted with alcohol and lipid solvents. Dead pieces of tissue have induced brain with eyes, glandular masses, limbs, muscle, and notochord from ectoderm. The mesoderm and entoderm also react but to a lesser degree than the ectoderm (Holtfreter).

The capacity to induce is by no means a property of any and all tissues and substances. Inert substances such as agar, starch, and paraffin have no effect. Plant tissues (such as banana and potato) have little or no inductive capacity (Holtfreter). Glycogen and cephalin, formerly suspected of inductive capacities, cannot induce when purified (Needham, Waddington, Nowinski, Lemberg, and Cohen). Egg albumin, pig fat, and animal charcoal are negative, while blood and fat of the mouse and certain muscles of vertebrates and invertebrates have only a slight inductive capacity (Holtfreter).

Needham, Waddington, and Needham showed that either extracts of amphibian eggs or of beef liver can induce neural structures. After saponification the inductive capacity of a given tissue such as liver remains mainly in the unsaponified fraction. Furthermore, the inductive substances are precipitated by digitonin which combines specifically with the sterols. This evidence points to members of the sterol group as the inductive agents (Needham, Waddington, Nowinski, Lemberg, and Cohen).

A group of German workers has claimed inductive properties for certain acids: thymo-nucleic acid and muscle adenylic acid (Fischer and Wehmeir). They have made similar claims for certain higher fatty acids such as oleic and linoleic acid.

Detailed accounts of this work have not yet appeared. Several synthetic, chemically pure substances (estrogenic hydrocarbons) have inductive capacities (Waddington and Needham).

Therefore, the conclusion that specific organs and tissues can be induced by the action of chem-

ical substances upon embryonic cells seems well grounded. Direct contact of the cells with the inductor is essential to the transmission of the effect. This fact alone has the greatest potential significance for the student of developmental defects. Any aberration of development which tends to prevent close contact with the inductors would prevent or modify the development of specific organs.

Research upon causal factors in the development of the separate organs and tissues of the body in numerous instances is revealing a setup like that for the neural plate. It will be sufficient to concentrate upon a few specific, well worked out instances to bring into relief those principles which seem of greatest importance to the student of the origin of developmental defects.

Induction factors are particularly clear in the development of the components of the eye. The optic cup, arising from the anterior portion of the neural plate, is induced by the underlying portion of the archenteric roof (Mangold, Spemann, Holtfreter) which is thus the inductor of the optic cup. Transplantation of this inductor under the belly epidermis of another germy gastrula results in the induction of a piece of brain with eyes in the foreign location. Removal of the inductor at the proper stage results in absence of the optic cup. The inductive process is evidently a step-by-step affair since a series of abnormalities including cyclopia and various degrees of fusion of the two optic cups can be produced experimentally by varying the stage at which the eye inductor is removed (Adelmann, 2).

Stockard and others, up to Wright and Wagner, have adopted the assumption that eye defects represent the environmental or hereditary influences exerted upon the eye material itself. Reinvestigations of the effects of noxious environmental conditions such as lithium chloride upon the appearance of eye defects have placed this former conclusion in doubt (Lehmann, Tondury). The development of the eye inductor is clearly abnormal in every case of cyclopia. An examination of the numerous extrapoptical defects which accompany cyclopia and otocephalia points strongly to the conclusion that the primary injury occurs in the eye inductor (Adelmann). On the theory of direct optical injury it becomes difficult or impossible to explain the abnormalities of the jaws, nostrils, and head muscles. The possibility of direct optical injury has not, however, been ruled out completely.

The optic cup in turn is the inductor of the optic lens (Spemann, 22) and here too the inductive action is evidently a step-by-step process.

The initial stages of the process result in the development of the lens vesicle, but this is not endowed as yet with the capacity to differentiate the lens fibers. Further influence of the inductor is essential to the continued development of the lens. Parts of the brain near the ear apparently can also induce lens (Huxley and DeBeer). The dependence of the lens on the inductive stimulus of the optic cup varies, however, in various forms that have been studied (Spemann 1918). This does not mean that the lens can arise without the inductor for the ectoderm never forms a lens if it is separated at a sufficiently early stage from the rest of the egg (Holtfreter).

The lens in its turn, is the inductor of the conjunctiva. A conjunctiva fails to form after the removal of the eye, the ectoderm remains opaque and pigmented. On the other hand, transplantation of the optic cup, the lens, a piece of retina, or even a macerated optic cup to the belly region results in the formation of conjunctiva out of belly epidermis (Huxley and DeBeer). This condition of multiple inductors for a given structure is apparently a widespread phenomenon. Just what the interrelationships of the several inductors are during normal development is still problematical. Possibly one of them is the predominant agent, backed up by the others if the predominant agent should fail to exert its effect.

Viewing the development of the eye as a whole, we see a chain of inductive reactions: Archenteric roof (organizer) — optic cup — lens — conjunctiva.

The chain of reactions involved in the case of ear development is especially worthy of notice since it illustrates another aspect of induction: the mutual effects. Ear vesicles are induced from early ectoderm by implantation of the organizer of the hindbrain portion of the neural plate or the anterior part of the neural crest (Holtfreter). The ear-forming ectoderm never forms anything resembling an inner ear if it is isolated completely from the ear inductors. The ear vesicle serves in turn as the inductor of the cartilaginous capsule of the ear. It was found early (Lewis) that abnormal chondrocrania, lacking in auditory capsules, follows extirpation of the vesicle. The effect exerted is probably a chemical one since other portions of the body such as olfactory pits and pieces of brain, or inert materials such as paraffin or celloidin, placed into the ear region do not stimulate the formation of an otic capsule (Kaan).

The capsule then exerts an effect back upon the ear vesicle, for in the absence of the constraining capsule the epithelium forms irregular cystic

vesicles rather than the typical membranous labyrinth (Kaan). This is apparently a purely mechanical effect. The membranous labyrinth is still, however apparently not freed from its dependence upon inductive stimuli from the hindbrain. Boonewie in a study of the waltzing mice, known as "Shakershort" mice found their behavior was due to degeneration of the labyrinth. Up to the eleventh day development is to all appearances normal. Then the hindbrain fails to send out nerves into the labyrinth, which subsequently degenerates. Apparently the nerve failure is the causal factor of labyrinth degeneration. Possibly the defective behavior of the hindbrain itself goes back to faulty induction by the archenteric roof but this has not been shown.

Quantitative aspects of inductive action have received comparatively little attention. However, there is promise of results of vital importance to the understanding of defective development. Mangold showed that the size of the neural plate is roughly proportional to the amount of inducing material. Microcephalia may be produced experimentally by a reduction in the amount of organizer (Tondury). The size of the mouth depends upon the amount of mouth inductor that contracts the ectoderm (Holtfreter 9). The amount of olfactory epithelium apparently depends upon the spatial extent of the stimulus emanating from the telencephalon (Holtfreter 9). An abnormally small lens results when the amount of optic cup is reduced (Spemann).

Many inductors are apparently equipotential systems in that portion of the inductor may induce a complete structure. Thus twins with separate but partly fused central nervous systems and notochords may be obtained by inserting a piece of tissue into the center of the organizer area (Bautzmann). Supernumerary proctodea may be produced by splitting the proctodeum at any early stage of development (Schechtman). The production of conjoined twins in amphibia by inversion of eggs probably involves a mechanical splitting of the organizer by shifting of the heavy yolk material under the influence of gravity (Penners and Schleip). Many of the variations of twinning recorded for man and the higher mammals may be duplicated experimentally in amphibia by proper surgical manipulation of the organizer. It is possible that some cases of supernumerary organs result from excessive amounts of inductor rather than from splitting. Holtfreter (9) found as many as five olfactory pits induced in close proximity by a single implanted piece of organizer. Possibly the inductive stimulus here was a very diffuse one.

By far the greatest part of the results of causal embryology have been and are being obtained from amphibia. The results thus far seem applicable to every vertebrate adequately investigated. In the chick, secondary nervous systems are induced from ectoderm by implantation of parts of the primitive streak (Waddington). Conditions essentially similar to those in the amphibia occur in teleost fishes (Oppenheimer). Waddington showed that in the primitive streak stage of the rabbit, the ectoderm of the embryonic shield develops into neural tissue if placed in contact with a piece of organizer from the chick. He (Waddington) later showed that the primitive streak of the rabbit can induce neural tissue in chick ectoderm.

It may be concluded that mammalian development like that of other vertebrates, is controlled by organization centers and that the primary organization center for the embryonic axis is the primitive streak (p. 288).

Some defects with a hereditary basis, such as the otocephalia of guinea pigs reported by Wright, the cases of human cyclops reported by Klopstock, and the microcephalia which is sometimes present in feeble-minded human beings, can be produced experimentally by injury to inductors. How the genes act in the production of hereditary defects is not known. Indeed it will not be known until more information is amassed on the basic problem of the relations of the genes to normal developmental processes. The possibility must be kept constantly in mind that genic effects like those of noxious environmental conditions, may be exerted not upon a given organ but upon one of the links in the induction chain leading to the development of the specific organ.

It is unnecessary to go on citing the inductors and induction chains which have been discovered. Each specific organ must be considered individually and, even then, only very tentative conclusions can be drawn since in practically all cases knowledge is still fragmentary. It is however clear from present day results that the variations in the properties of inductors must be included in concepts concerning the origin of developmental defects.

#### STATISTICAL STUDY

We are indebted to Douglas P. Murphy for his exhaustive study of many phases of the problem of congenital malformations. In the files of the Bureau of Vital Statistics, Department of Health of the State of Pennsylvania, 130,132 death certificates for stillborn and liveborn individuals who died in Philadelphia during the 5 years between January 1, 1929 and December 31, 1933 were examined. In 1,476 of these cases, the existence

of a congenital defect was noted. This defect was either on the body surface or, if internal, had been discovered either by operation or autopsy and confirmed in 890 of the original 1,476 cases. For the various studies an attempt was made to interview the mother of each of these 890 individuals. The visits were made by fourth year medical students. Controls were located through the licenses on file in the Marriage License Bureau of the City of Philadelphia for the years 1929 through 1933. Ninety per cent of the defectives studied were either stillborn or died within a year of birth.

**Race.** Deaths due to or associated with the presence of congenital malformations in white persons in Philadelphia for the 5 year period studied occurred at the rate of 9.6 per 1,000 of all deaths of white people. For the negro population the rate was 5.2 per 1,000, making the malformation death rate in whites nearly twice that of the negroes. Murphy states that the figures from the United States Bureau of Census also show that congenital malformations occur much less frequently in negroes. The frequency of such defects in the yellow race lies between these two extremes. If syphilis is about twice as common in negroes then Murphy's investigations suggest that syphilis plays little or no role in the production of congenital defects.

**Sex.** Males and females were affected equally by congenital deformities.

**Birth Order.** The birth order was studied in each normal and each malformed child. This investigation was prompted by various conflicting reports. Still had concluded from a study of malformed children that congenital heart disease and congenital pyloric stenosis appeared more often in the first born than in the later born. Macklin reviewed 1,000 cases in the literature and concluded that there apparently was no more likelihood of defects in the first than in the later born. Studies made on the birth order of mongols by Pearson and Ordahl all agree that mongols occur more often among the later births than could be expected by chance. Murphy found that the defects occurred in the first 4 children in families with practically equal frequency. However from the fifth child on, the incidence of malformations rose rapidly. Thus the seventh child appeared to be malformed twice as frequently as did any of the first four children.

**Maternal age.** From a study of 607 cases it was found that malformed children were born more often to older mothers than to younger ones. Between the maternal ages from 15 to 30 years the defective children appeared with about equal fre-

quency but the frequency of malformed children became three times that which was observed during the period before 30 years of age after the mother became 40 years of age.

*Month of conception* Contrary to the reports published by Petersen and Paddock, Murphy found that his study offered no evidence for the belief that the conception of defectives is related in any manner to weather condition. In Philadelphia the greatest frequency occurred in the summer months which is exactly contrary to Petersen's findings.

*Reproduction before and after birth of malformed child.* Miscarriages and abortions were observed to appear in close relation to the pregnancy which ended in the birth of the malformed child. Premature births and stillbirths also were in evidence. Moreover these disturbances occurred most often in the pregnancy just preceding that which ended in the birth of the defective and next most frequently in the one just following. It was concluded that if a defective child is to be born, it is more likely to follow an abortion, a miscarriage, a stillbirth, or a premature birth.

*Type of defect to appear in a second malformed child.* In a series of 40 families having two or more congenitally malformed children the defect observed in the first child occurred in one of the subsequent defective children in 47 per cent of these cases.

*Duplications of malformations among distant relatives.* In 39 cases a distant relative of the malformed child showed a congenital malformation. This defect was identical in 41 per cent of the instances.

*Frequency of defects among brothers and sisters.* This study was done in an attempt to throw some light on the question of the possibility of parents of a congenitally malformed child having more malformed children. The investigation covered a consecutive series of 375 families each known to have had a congenitally malformed child and also one or more subsequent members. Thirty-four or approximately 12.4 per cent, of the families produced one or more additional congenitally malformed members.

From this study it is concluded that the offspring presenting congenital malformations which are serious enough to warrant being recorded on death certificates are approximately 24 times as likely to occur in families possessing a congenitally malformed child as in the population at large.

*Relative sterility before birth of malformed child.* The lengths of intervals between 2146 pregnancies of mothers of malformed children were determined. A long period of relative sterility occurred four

times more often immediately preceding the conception of the malformed child than at the birth of a normal child.

*Duplication of rare defects.* Maldevelopment occurs more frequently in the left dome of the diaphragm than in the right dome. One mother gave birth in successive pregnancies to 2 children, both with an absence of the right dome.

*Duplication of defects through two wives.* One father had a child with a cleft lip and a cleft palate on the right side by each of 2 wives.

*Frequency of reproduction.* Two hundred and eight families each had 2 or more children born before the birth of the congenitally malformed child. There was no significant difference from a series of control families. Thus rapidly repeated childbearing was not found to be a predisposing cause in the production of congenital malformations.

*Diet.* The diets of 545 mothers were investigated. No significant deficiencies were found.

*Coincidence of malformation with placenta previa.* Placenta previa occurred once in 741 malformation pregnancies. The frequency in the general population as quoted from Williams is about 1 in 1,000 cases.

*Parental age difference.* This study was based on an investigation of 600 parents with defective children and 600 controls. It was concluded that there is essentially no difference in the distribution of parental age differences.

*Intervals between pregnancies.* Based on a study of 531 families, it was concluded that mothers of congenitally malformed children tend to experience a more or less prolonged period of reproductive inefficiency at the time that the congenitally malformed children are born.

An exceedingly large number of malformed offspring were born after nonpregnant intervals of more than 4 years duration.

#### RUBELLA, CONGENITAL DEFECTS FOLLOWING MATERNAL INFECTION

The most interesting and apparently definite association between virus disease and congenital defects was first brought out by H. McAllister Gregg at the annual meeting of the Ophthalmological Society of Australia in October 1941. Rubella was widely prevalent in Australia during the years from 1937 to 1942 and there was an epidemic in New South Wales in 1940. During 1941 cases of an unusual type of congenital cataract were being seen in Sidney. Gregg states that these cases all showed a remarkable similarity of the opacities in the lens and frequently presented an accompanying affection of the heart. The cat-

facts were of the dense nuclear type and according to Gregg there was no similarity in their appearance to any of the morphological types of congenital and developmental opacities reported previously. It was postulated, on the basis of the widespread geographical incidence, that some common factor was at work. The German measles epidemic of 1940 seemed to be a likely suspect.

Gregg reported a series of 78 cases of congenital cataract which occurred in babies between December 1939 and January 1941. In 44 of these babies a congenital lesion of the heart was also noted. The mothers had suffered from rubella during the early stages of pregnancy.

In a later report Gregg, in discussing congenital defects in general, wonders if disease other than rubella may not have a harmful effect on the developing embryo. This author regards rubella and its sequelae as but one chapter in the full story. Previous to 1940 cases of congenital defects following maternal rubella during pregnancy had occurred but the relationship had not been recognized.

On the basis of Gregg's preliminary observations, a committee was appointed by the Director General of Public Health of New South Wales to investigate the occurrence of congenital defects in children following maternal rubella during pregnancy. This report was based on a study of 180 cases of children suffering from congenital defects. The committee was satisfied that the maternal infection was rubella with "possibly an increase in the virulence of the organism." The defects noted were deaf mutism, eye and heart disease, and possibly mental defectiveness. A large number of the affected children were below normal average birth weight and showed a degree of microcephaly. The majority were below average in physical development. A retardation of eruption of the teeth was noted but all had their normal complement at 3½ years of age. Dental defects in some of these cases had been described by Evans.

The committee further concluded that if the maternal infection occurs after the second month of pregnancy there is less likelihood of eye defects. No relationship was established between the severity of the maternal infection and the nature of the defect in the child. There was no evidence collected to show that there was any harmful effect on the mother or on the subsequent pregnancies. The children affected were regarded as mentally retarded rather than mentally defective. The deafness was not absolute and there was apparent improvement in hearing about the latter part of the fourth year.

Sivan *et al.*, in 1943 confirmed Gregg's findings. Their conclusions were based on a study of 49 mothers who had suffered with rubella during pregnancy 4 who had no knowledge of any disease during pregnancy none who had suffered from morbilli and 2 who had suffered from mumps. All these cases occurred in the years 1939 to 1943. Among the cases of rubella during pregnancy 31 of the infants born subsequently had congenital defects. The abnormalities noted were cataract deaf mutism heart disease microcephaly and mental retardation. With 2 exceptions, all of the 31 mothers had contracted rubella within the first 3 months of pregnancy. If the rubella occurred during the first 3 months of pregnancy every infant showed some defect. After the third month of pregnancy rubella caused practically no harm to the fetus.

No congenital defects were found in babies born subsequent to the occurrence of morbilli in pregnancy. Swan *et al.* record one case of congenital corneal opacity following mumps in pregnancy.

Numerous reports have followed from England and the United States. Prendergast in the fall of 1944 made a survey in California on the incidence of congenital malformations among children whose mothers had rubella during the first 3 months of pregnancy. The reports were made by 37 ophthalmologists 24 pediatricians, and 32 obstetricians. Although it was believed that there was probably some duplication of cases 80 cases of congenital cataract, 10 cases of other ocular defects 32 cases of cardiac defects, and 10 cases of other congenital anomalies were reported.

Because of the greater number of cases reported from the Western United States, Prendergast raises the question as to whether such congenital defects are more prevalent in the Western United States or whether the condition has spread from Australia to the Pacific Coast. The question of virulence of the virus is also raised. The malnourished appearance of the infant at birth with the inevitable feeding problems and lack of normal development were also noted in these cases.

Fox and Borten have reported 5 cases of maternal rubella in the first 2 months of pregnancy with only 1 abnormal child (stillborn and hydrocephalic). However the preponderance of evidence would suggest that all of the mothers who contract rubella during the first 2 months of pregnancy and half of the mothers who contract it during the third month of pregnancy will give birth to infants with congenital defects.

Rubella has been rather definitely established as a virus infection (Hiro and Habel). Mann as reported by Gregg was of the firm opinion that it



had been proved beyond question that there is a causative relationship between a virus infection early in pregnancy and the appearance of certain congenital defects in the child. Only those cells which are in active division would be affected. Gregg states that the lens of the eye and the inter ventricular septum develop between the fourth and eighth fetal weeks of life.

#### EXPERIMENTAL EVIDENCE

Sokolow after examining 1,302 healthy and 1,835 sick children, concludes that sick children possess a greater number of complications of extreme morphological variations than healthy children. The basis of these inferences is that these children are constitutionally inferior. Of 172 healthy infants, 10 or 5.8 per cent had deformities. Of a second group of 158 sick infants, 39 or 24.6 per cent had deformities.

The report of Harris on Stockard's attempts to explain human abnormalities on the basis of his experiments with heavily alcoholized guinea pigs, and on the efforts of Durham who repeated the experiments but was unable to verify them or find any change in the offspring, suggest that the problems of artificial production of abnormalities should not be loosely applied to the human being. The largest number of pathological ova and embryos are found in the first 8 weeks, after which time the number decreases. Pathological ova that survive the eighth week tend to live and are born as monsters. It has been suggested that threatened abortions early in pregnancy should not be treated by rest and quiet because it is quite possible that the uterus is attempting to rid itself of a pathological ovum. Studies of pathological ova by Harris indicate to him that ectopic implantation is a greater factor than uterine disease and that both are more important factors than maternal or paternal germ plasma. Of ectopic pregnancies, as many as 95 per cent produce monsters. This anatomical fact, Harris feels, is a strong argument against the germinal theories in the production of monsters. The primary theory in the majority of cases is that the environment of the ovum, through faulty implantation of the chorion, malnutrition of the ovum, or actual uterine disease, prevents normal development. The argument for environment as against the germ plasma is afforded by experimental teratology. By experiments almost all main types of monsters occurring in man can be produced artificially in the laboratory by interfering with the nutrition or environment of the normal ovum after fertilization. Examples of this are afforded by Spemann who produced double monsters in a frog by tying

a fine thread around the egg. Loeb showed that the heart's development could be checked by the addition of certain percentages of calcium.

Morgan produced spina bifida in frogs by raising the concentration of common salt each day. Stockard, Spemann, and others have produced cyclopia in fish and frogs by the action of magnesium salts. Warkany has caused harelip, cleft palate, fusion of the chest bones, and malformation of the claws in rats by withholding riboflavin from the diet. In all of these experiments, irrespective of method elected—chemical, thermal, or electrical—the malformation has been caused by interference with normal growth.

Harris states that from a study of human embryological material it has been estimated that only 1 infant in 20 showing deformity of the extremities has any family history. Against the view that many deformities of the limbs are due to mutation in the germ plasma are the proved examples wherein such deformities die out in later generations. This tendency of deformities to die out within three or five generations, Harris contends, is today awaiting explanation in terms of mutation of the germ plasma.

Ball held that a defective maternal environment—usually in the nature of faulty implantation—is the source of morbidity in mammalian embryos. Moreover he thought that pathological human ova and those obtained in the laboratory on experimental animals were identical.

Stockard has attacked the problem by experiments with the marine minnow *Fundulus*. Apart from those anomalies which are admittedly hereditary and transmitted through the germ plasma, this investigator believes that he has reduced the primary cause of all abnormal developments, including twinning, to a single factor mainly developmental inhibition or arrest. In this conclusion he is in agreement with Newman's conception of monster production through the lowering of the developmental rate. The exact type of deformity that results depends solely on the precise moment when the interruption occurs. All anomalies may be induced by the same kind of experimental treatment, while any particular type may be produced by a wide variety of different treatments. Stockard's method was a lowering of the temperature or diminution of the oxygen supply which means a reduced metabolism, and specifically the retarding of oxidation, and this is identified as the causal agent behind arrests and all anomalous development. The success of the procedure rests on the observation that the developmental rates of the embryo as a whole and of its component parts are not uniform on the contrary periods of rapid

progress alternate with moments of relative quiescence. Artificially slowing development during a time of normal retardation has little or no effect, whereas the same treatment during a phase of activity is productive of abnormalities. As to individual malformations, there are critical moments in the development of every organ or part which are characterized by rapid cell multiplication. At such times this particular proliferating region is dominant and may even exert a depressing influence over the growth of other parts. If this favorable moment for differentiation is not taken advantage of the transient supremacy of the organ is lost and in turn it submits to depression by other parts assuming their dominant periods. The result is a reduced or imperfectly formed region which has missed its opportunity to express itself completely or perfectly in competition with other parts. The conclusion is that each organ not only originates from a definite embryonic area or primordium and from no other but also that it arises at a very definite moment which must be utilized at that time and no other. Corner studied 535 pregnant uteri from the domestic sow and noted that the ova and embryos of fertile parents suffer pathological change in the midst of a normal environment. This was discovered by histological examination of the uteri. Moreover the defects of ova and embryo occurred at all stages of pregnancy and were not all dependent upon specific maternal causes such as faulty implantation. Thus, Corner concludes that embryonic morbidity arises in part from internal defects of the germ cells and embryos.

The work of Bagg and Bagg and Little is of importance in this study. Mice were subjected to roentgen rays and later bred. Among the congenital deformities appearing were those of some of the extremities. These mice were then interbred for nineteen generations with a suitable control group of animals. Many fetuses were examined in utero and if they showed deformity they were identified by the amputation of their tails and then allowed to go to term. Of 5,000 studied in the inbred series, 413 had foot defects: 300 clubfeet with syndactylism, 9 syndactylism alone, 27 hypodactylism, 16 congenital amputations, and 93 polydactylism. Bagg concludes:

The earliest foot defect is associated with the formation of a blister like bleb which raises the epithelium of the foot usually in a localized area. This condition is usually found during the twelfth to the fifteenth day of prenatal life, and is followed by the escape of blood into the bleb and the formation of a localized blood clot. These blood clots may persist until birth.

The extent of the pathological process and its anatomical location determine whether the later developing foot is to show either congenital amputation, clubbing, hypodactyly, polydactyly or syndactyly.

Polydactyly in my experimental strain of animals may also be an expression of localized arrest in embryonic development.

Abnormalities of the limbs are definitely inherited. They are recessive to the normal in inheritance. When considered as one of the manifestations of a general tendency to abnormal structure they approach the Mendelian expectation in behavior.

Bagg further explains hyperplasia by referring to Stockard's work on arrested development as quoted and believes that such an arrested development occurred in the 12 instances of polydactylism found after the 5 year examination of 528 animals. Of these 12 8 showed polydactylism with a slight moderate clubbing, 1 polydactylism and syndactylism in the same foot and 3 polydactylism and hypodactylism. Remnants of hemorrhages were found in 8 of these animals.

Bonnevie continued the observations of Bagg and Little. She found that the clear blebs contained cerebrospinal fluid that escaped into the subcutis through the foramen arterius an embryonic structure on the roof of the fourth ventricle. This structure is normally a safety valve guarding against increased cerebrospinal pressure in the embryos and vertebrates. It exists prior to formation of the foramen of Magendie. In embryos developing blebs, the amount of escaping fluid or the rate of flow is increased. It is observed that the fluid has a tendency to collect in the concavities of the embryonic surface and ends in the limb buds and that the blebs are apt to be damaging to the further development of the embryo only if there was extravasation of blood into them. The preponderance of lesions on the left side is considered to be due to the intrauterine position or right-sided twist assumed by the mouse embryo.

Engel lists a series of congenital syndromes in which the formation of spinal fluid blebs in the subcutis of the human embryo may constitute an etiologic mechanism. He finds the present differentiation artificial and notes that all of these syndromes have in common a combination of anomaly of the skull deformity of the extremities, and a tendency toward familial occurrence. Among these conditions are Mongolian idiocy, cranio-carpodactylodysostrophy, and oxycephaly. These are under the blood disorders and are regarded as comparable with the experimental conditions produced in the Bagg and Little mouse strain.

Kanavel does not accept this interpretation of hyperplasia or its application to reduplication, and speculates upon whether it might be due to metaplasia of the cells in the involved part secondary to an injury of the vascular or nervous system in the germ plasma. Further he asks why the known predilection of these deformities for certain parts of the arm and forearm still remains unexplained.

Browne puts forth the interesting theory that mechanical pressure may play a part in causing certain bony deformities. He substantiates his premise with photographs showing talipes equinovarus, double talipes, malposition of the toes, postural torticollis, and fractures of the tibia. His excellent pictures show pressure dimples over points of contact of the feet, hands, elbows and heels in such a way as to make this rather extreme hypothesis seem quite plausible.

Because of the increased hydraulic pressure, Browne reasons the waves of blood sent into the fetal circulation supply the muscles of the viscera closest to the impulse and that the areas furthest away suffer from not only reduced arterial blood supply but also from venous stasis. Hence degeneration of muscle and stiffening of the joints would occur.

Certain other deformities of the extremities and maldevelopments have been traced to incomplete development of striated muscle and its replacement by either fatty degeneration or connective tissue. The muscles have also been lacking in striation. It would seem, however, that this lack of muscle development is just one phase or process of the problem.

Streeter reduces the problem to the egg itself and offers six specific examples of the character of egg material:

1. Variation in egg quality. This variation is shown in the work of Corner.

2. Variation in vitality of the body cells. Various cells such as fat and intestinal epithelium can live 18 hours under the same influences as kidney epithelium which persists after 120 hours. Carrel's experiment with the longevity of heart muscle is another example.

3. Excessive growth response such as by gigantism when confined to a special part of the body.

4. Deficient growth response, instanced by interuterine amputation. Further reference is made to the controversial question of umbilical cord and amniotic band influence. Because this particular example is thought to be an important factor in deformities, Streeter's opinion is worth recording here. He states that this condition

occurs in living infants otherwise normal, but that to be tenable the cord should be caught in the act of constriction and the tissue proximal to the constriction must be living, while that which is distal must show signs of disturbed circulation and necrosis. Moreover the cord must maintain its own circulation although tight enough to constrict the limb.

The amniotic bands and adhesion theory can be no better supported. The embryology of the amnion reveals its close approximation to the germ disc, and if one is involved, so must be the other. Moreover the extremely early period of the finding of deformities, for example, long before limbs appear as such, seems to aid in refuting such a theory.

5. Variation in organ performance. The example offered here is that even in extremely grotesque areas not everyone suffers from goiter. The specificity of ketoids is another individual variation.

6. Tissue vulnerability. Experiments in the laboratory have shown one strain of rats to be more susceptible to rickets than another and also that the first strain's lack of resistance to rickets can be raised by breeding.

Streeter offers further interpretation of the normal disparity inherent in the germ plasma and hereditarily transmitted. A given tissue may have abnormally great or deficient growth potency. The damage done depends upon the part and area involved. There seems to be a predilection for mesenchymal and particularly subcutaneous connective tissue involvement.

M. Jansen supports the amnion theory by a division of fetal life into three stages. During the middle one lasting from the fourth week to the fifth month the amnion envelops the fetus but has not fused with the chorion. Moreover the hydrostatic pressure is raised. Hence in this second stage smallness of the amniotic sac and consequent rise of hydrostatic pressure in it will cause the blood of the fetus to flow into the placenta until, in the latter the widening of the blood vessels has led to a like rise in pressure. The fetus then suffers from famine.

This may cause death and fetal expulsion. If not death, then the fetus will lose its power of growth—it will be dwarfed. At the end of the second stage the amnion may cause undue flexion of the hip. It would seem that Jansen's theory would be more applicable to bone deformities.

Hellner experimentally produced amputation by tying cords about the extremities of rabbits' embryos while in utero. His conclusions are that the responsibility must be traced to the gene if

it is amniotic in origin there is only an occasional end defect

## CONCLUSIONS

1 A brief summary of some of the current theories of congenital deformities has been presented

2 It is apparent that both genetic and environmental forces may lead to malformations of the same type, to malformations of identical or similar anatomical appearance. This implies that identical malformation may be hereditary in one case and nonhereditary in another. Warnkany

3 The prevention of deformities still requires a great deal of study but much assistance and both encouragement and warning can be offered parents with a congenitally malformed child

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# ABSTRACTS OF CURRENT LITERATURE

## SURGERY OF THE HEAD AND NECK

### EYE

**Xeroderma Pigmentosum with Affection of the Eye.** JOHAN SAEK. *Brit J Ophth* 1948 31 398.

Xeroderma pigmentosum is a rare hereditary actinic dermatosis which is characterized by brownish maculae sensitive to sunlight and the development of multiple malignant cutaneous tumors. Ocular complications include ectropion, pigmented conjunctival tumors, telangiectasis and papillomas of the limbus and cornea proper.

Three cases of xeroderma pigmentosum with ocular involvement are reported. The first case was that of a girl 17 years old with freckles on the face and extremities, who developed a pigmented tumor at the right temporal limbus resembling a pterygium. Excision was followed in 2 years by a recurrence which disappeared entirely with local x-ray therapy. Eight years after the pterygium was first diagnosed she developed a basal cell carcinoma of the right cheek which responded to radium treatment. Malignant tumors continued to form but were controlled by radium or x-ray therapy. This patient's brother, age 32, had brown spots on his face and extremities, was sensitive to sunlight, and suffered from photophobia. Since the age of 27 years he had had many malignant tumors and ulcers of the skin which had been treated with roentgen rays or radium with good results. The right eye showed a red spot close to the limbus which consisted of localized dilations of episcleral vessels and was considered part of the disease.

The third patient, a 10 year old male, had a bluish white hard insensitive cauliflowerlike tumor at the nasal limbus of the left eye. Eight years later the mass covered the eye and the face showed large and small telangiectases, nevi and angiomas. Treatment was refused and subsequently both eyes had to be enucleated because of pain; the new growths spread gradually over the face and the patient died at the age of 21 years.

The author emphasizes the fact that xeroderma pigmentosum must be kept in mind in cases of seemingly benign ocular tumors appearing in conjunction with pigmented spots in the skin.

FRANK W. NEWELL, M.D.

**Ocular Lesions Following Atomic Bombing.** JOHN J. FICK. *Am J Ophth* 1948 31 137.

The author was able to study numerous cases in which there were ocular lesions following atomic bombing. The lesions resulting from the explosion of the atomic bomb may be divided into three categories: (1) mechanical injuries from the blast, (2) thermal injury from long wave energy, and (3) radi-

ational injury from gamma rays and neutrons emitted at the time of detonation.

The mechanical injuries differed in no way from those produced by other explosive agents.

The thermal injuries from long wave energy were evidenced by pigmented flash burns and copper colored burns of the side facing the explosion. Some of these burns involved the cornea and produced red inflamed lacrimating eyeballs.

The ocular lesions associated with radiation were limited to the retina as far as clinical features were concerned and were found in 46 cases. The following types of hemorrhage were observed: (1) flame shaped hemorrhages, (2) preretinal hemorrhages, (3) Roth type hemorrhages, (4) vitreous hemorrhages. Case histories are cited.

In conclusion it is pointed out that the transient nature of the condition prohibits any definite conclusions as to the pathogenesis of these lesions. It is the author's opinion that exudative lesions represent the milder involvement. It seems safe to conclude that the ocular lesions here described are directly related to the deficiency in blood elements and in no way directly related to the action of radiant energy on the eye.

J. WOODHULL OVERMAN, M.D.

**Vertical Anomalies. Presentation of Vertical Anomalies in 100 Cases Studied.** BEULAH CUSHMAN and LOUIS SARRO. *Q Bull Northwest Univ M School* 1948 22 17.

The authors present a study of 100 cases of vertical anomalies associated with lateral deviations. The etiology of vertical anomalies is discussed. The necessity for a complete diagnosis of the squint is pointed out, for the success of treatment, whether surgical or nonsurgical, is dependent upon it.

The summary and conclusions of White and Brown who discussed the problem of vertical anomalies before the American Academy of Ophthalmology and Otolaryngology in 1938 are given.

In 71 of the 100 patients studied the vertical anomaly was so definite that surgery was necessary on the elevators or depressors. The majority of the vertical anomalies occurred in patients with convergence excess among a group of 48 patients, 44 had vertical anomalies.

Thirteen patients with convergence insufficiency required surgery to the medial recti. In 7 of these vertical anomalies were present.

Vertical anomalies were found in 8 of 21 patients whose condition was diagnosed as divergence excess.

Of 19 patients in whom a diagnosis of divergence insufficiency was made, 12 had vertical anomalies.

Simple vertical anomalies were present in 5 patients without the association of any center anomaly.

In conclusion the authors state that the diagnosis of any ocular muscle imbalance should always include the individual muscle anomaly as well as the type of center anomaly. Vertical anomalies should be suspected in every patient with an ocular muscle imbalance.

J. WOODRUFF OVERTOR, M.D.

**Experimental Corneal Transplantation.** HERBERT M. KATZ and P. K. KOO. *Am J Ophth.*, 1948, 31, 7.

Although corneal transplantation has been studied since 1824, the biologic process that takes place between host and graft remains as yet incompletely understood. The authors summarize the literature on corneal transplantation both human and experimental, and discuss the evidence in favor of true healing versus replacement of the graft.

Experimental studies are presented with sections showing normal healing as well as operative complications. It is pointed out that corneal tissue is unique in its properties of transplantability.

The material presented was obtained from a study of over 200 corneal transplantations on rabbits, and over 100 histologic sections of operated eyes. Several important factors in corneal transplantation have been learned from the study and others have been inferred. In order for the corneal graft to remain clear and heal properly it must be obtained from fresh, viable cornea of the same species. The epithelium and probably the endothelium are replaced in the graft by the appropriate cell layers from the host. The healing that takes place at the stroma level involves the ingrowth of a great number of fibroblasts or keratoblasts from the host. The authors are not sure as to the fate of the stroma cells in the central part of the graft but in view of the fact that bodily tissue cells are normally replaced from time to time in the course of their metabolism they believe that this also occurs in the cornea and that, over a period of years, the stroma cells replace the donor cells so that eventually the host takes over. It is pointed out that the graft must be surrounded by a sufficient number of normal corneal cells and the transplanted cornea must be sufficiently viable so that a large portion of its structure does not need to be replaced rapidly. When rapid replacement occurs the resultant membrane is translucent.

Anterior synechias are very prejudicial to the success of the graft. They form the basis for vascularization, fibrosis, glaucoma and iridocyclitis. Anterior synechias can be avoided by careful coaptation of the margins of the wound and thorough dilation of the pupil.

The authors do not agree entirely with either extreme point of view as to the biological process taking place in corneal transplantation but do agree in part with each.

The authors believe that in successful cases the cellular elements of the transplant are replaced by the host and that the intercellular structures of the graft are accepted and persist.

J. WOODRUFF OVERTOR, M.D.

**Results of Surgical Treatment of Congenital Cataract.** WILLIAM COOGLIMAN OWENS and WILLIAM F. HUGHES, JR. *Arch. Ophth.* Chic., 1948, 39: 339.

Criteria for estimating the visual prognosis in congenital cataract were derived from an analysis of 531 eyes operated at the Wilmer Ophthalmological Institute, Baltimore, in the period from 1925 to 1943. Associated ocular defects such as nystagmus, strabismus, and microphthalmos were discovered in some what over half the patients. In the group of patients who were free from such defects the best visual results occurred in those operated upon at 3½ years of age or later. Of these 70 per cent secured satisfactory vision (20/70 or better) and 16 per cent were considered failures (acuity of less than 20/200). When the cataracts in otherwise normal eyes were operated upon before 3½ years of age, only 9 per cent of patients secured satisfactory vision and failures occurred in 36 per cent. In contrast, 14 per cent of the eyes with associated defects, when operated upon at 3½ years of age or later, secured satisfactory vision and 35 per cent secured inadequate vision but among infants operated upon under 3½ years of age no case of satisfactory vision resulted.

Adequate vision followed linear extraction when done primarily or shortly after dissection, in 76 per cent and 78 per cent of the eyes respectively, dissections alone gave a comparable result in only 29 per cent. Secondary operations to clear the pupillary space were required much less often in the cases of linear extraction. The maturity of the cataract bore no relation to the complications or visual result.

With the best modern technique the prognosis for good vision in senile cataract is 95 per cent. The poorer results in congenital cataract are attributable to either gross or obscure associated ocular defects.

In the discussion, Cordes maintained the view that if the opacities are sufficiently dense to interfere with fixation the first eye should be operated upon at the age of 6 months. He agreed that linear extraction was the operation of choice irrespective of the age of the child.

JAMES E. LEXERSON, M.D.

**Vascular Fundus Disease with Especial Reference to the Classification of Gifford and MacPherson.** HAROLD PORTERMAN. *Q. Bull. Northwest. Univ. M. School* 1948, 74.

The author presents the Gifford and MacPherson tentative classification of vascular fundus disease (1940) and discusses ways in which it might be improved. The classification of fundus conditions seen in patients with cardiovascular renal disease was proposed for the purpose of teaching those unfamiliar with vascular fundus disease to orient themselves and make headway in a subject which would otherwise totally confuse them.

There are five groups in the classification. Groups 1 and 2 show the localized vascular changes associated with arteriosclerosis. Groups 3, 4 and 5 show the various stages of diffuse arteriolar constriction. The chief vessel changes which may be observed in patients with arteriosclerosis are given.

The author points out that it is difficult to decide on and enumerate the findings which serve to differentiate one condition from the other. It is this latter ability which is absolutely essential in teaching and it is often the basis for the distinction between a good textbook and a poor textbook, a good teacher and a poor teacher. It is stated that certain inconsistencies become less apparent if subgroups are added to groups 3 and 4 and if groups 1 and 2 are reserved for senile sclerosis without hypertension and retinal arteriosclerosis with hypertension.

In conclusion the author points out that the classification of Gifford and MacPherson fulfills the purpose for which it was proposed and its further use is recommended.

J. WOODHULL OVERTON M.D.

**Melanomas of the Uveal Tract** ROBERT E. KENNEDY  
*Am J Ophth* 1948 31 159

Cysts occurring in malignant melanomas of the uveal tract are chiefly of pathological interest but may in themselves present a clinical picture with a complicated diagnostic problem.

When cysts occur in ciliary body melanomas which extend behind the lens, and in melanomas of the choroid and iris which can be readily observed there is no additional diagnostic problem. However malignant melanomas projecting into the posterior chamber from the posterior surface of the iris or from the ciliary body may be difficult to differentiate from simple cysts. This diagnostic difficulty may be enhanced when malignant melanomas in this position become cystic. Reports have appeared in the literature of at least 8 cases of benign cysts of the posterior chamber in which the eyes have been enucleated following the diagnosis of malignant tumor, hence the differential diagnosis between cystic melanoma and a benign uveal cyst may be difficult. The author reports several cases to illustrate this problem.

The determination of translucency and the diagnostic puncture may differentiate a solid and cystic mass in the posterior chamber but cannot differentiate a benign and malignant cystic mass thus they are unreliable diagnostic procedures.

When possible, iridectomy and microscopic examination should be used to diagnose such lesions when their diagnosis is in doubt.

Large cystic spaces in malignant melanomas arise from the growth of small focal areas of tumor necrosis which are the result of inadequate nutrition.

The cystic manifestation is present in about 8 per cent of all malignant melanomas of the uvea, has no predilection for the site in the uvea or the cell type and has no apparent effect on the prognosis of malignant melanomas.

J. WOODHULL OVERTON M.D.  
**Review of 100 Cases of Retinal Detachment** RUTH APPELEY and D. K. PISCHEL. *Am J Ophth* 1948 31 796

The authors analyze 100 consecutive cases of idiopathic retinal detachment in which electrodiagnosis was employed. They point out a number of important features of retinal detachment work

The most common symptom was a shadow or curtain coming across the eye (44 patients), black spots or floaters (31), flashes of light (14) and blurred vision (39).

Retinal tears were found in 88 per cent of the cases. The horseshoe-shaped tear was most common (58 per cent of the cases). There were also round holes (33 per cent), macular holes (2 per cent), linear and oval holes (7 per cent), irregular rents (5 per cent), crescent-shaped (3 per cent) and oral disinsertions (10 per cent). The following types of detachments were found: 35 per cent were bullous, 33 per cent were flat, 32 per cent were bullous and flat, and 21 retinas were totally detached (15 of these were cured).

Because successful reattachment depends on closure or sealing of one tear or of several tears, careful localization of retinal tears cannot be overemphasized. The site of a tear is not necessarily at the area of greatest detachment; it may be found in a flat or in an apparently attached area of the retina. In some cases a tear may become visible only when the retina settles back following bed rest. In other cases previously visible tears become displaced into the periphery or do not stand out because of the lack of color contrast.

The history and repeated examination may actually reveal or serve as a clue to the possible location of a tear.

Tears are localized with the hand perimeter as to arc and meridian. An arc of 50 degrees represents a point 15 mm posterior to the limbus and each 5 degrees of arc is equal to approximately 1 mm.

Preoperative management consists of bandaging of both eyes and absolute bed rest for 4 or 5 days in a position that is most dependent for the retinal tear. In half the cases the retina settled back but no change was noted in 15 cases and in 3 cases the detachment increased.

**Surgical management.** Under local avertin anesthesia the horizontal meridian of the eye was marked at the limbus prior to the retrobulbar injection. The conjunctiva was incised 8 mm. from the limbus and with Tenon's capsule was separated from the sclera posteriorly. The tear was localized with the ophthalmoscope and an Arruga spoon and gentian violet were used to mark on the scleral surface the position of the tear. Partial penetrating Pischel electrodes and the Rose Walker diathermy machine were used employing 50 milliamperes for 2 to 3 seconds. Two or 3 spots of diathermy were placed from 1 to 2 mm behind the localized tear and the fundus was examined to ascertain that these were in actual relation to the tear. If the spots were not visible as in cases of elevation of the retina a Pischel pin was inserted over the localized area on the sclera to serve as a guide. A double row of coagulations was given about the tear coming up to the ora serrata (8 mm in emmetropes and 9 mm in high myopes). Cystic areas were included Pischel pins (usually 9 to 12) were inserted within the loop of diathermy barrage for drainage. If no drainage was obtained from the pm openings perforating electrodes or trephine



openings were used. In 10 cases air was injected into the vitreous chamber to push the retina toward the choroid.

Postoperatively the patients were kept in bed with binocular bandages for 3 weeks. The first of daily dressings was done on the second postoperative day and stitches were removed on the seventh to tenth day when the fundus was examined. After 14 days, peephole glasses were substituted for bandages and worn for an additional 6 weeks with the patient's activities limited.

It is concluded that the smaller the extent of the detachment the better the chance for surgical success and that retinal detachment should be treated as an emergency with immediate hospitalization and operation as soon as the retina has settled back to the normal position. On the basis of permanent reattachment regardless of the resultant visual acuity or of the peripheral field 86 per cent of the patients were cured. (A second diathermy operation to obtain reattachment was done on 13 eyes in 10 cases the operation was successful.)

JOSUVA ZUCKERMAN, M.D.

### EAR

**Surgery of Aural Suppuration after Radical Mastoidectomy** J. A. HARRISON, *J. Lar. Otol. Lond.*, 1948, 6: 435.

The article deals with the surgical management of aural suppuration following radical and modified radical mastoidectomy. The pathological processes causing such suppurations are commonly located around the middle ear ossicle of the eustachian tube in the hypotympanum, the anterior superior part of the attic, the incus or malleus, the petrous bone around the semicircular canals, and, rarely in the petrous apex. Surgical exposure and removal of the hypotympanic suppurations are accomplished by an anterior inferior endaural incision at the osteocartilaginous junction. Skin and periosteum are elevated and removed and the bone of this portion of the bony external canal is removed. Granulations and infected cells in the hypotympanum are exenterated with the curet. Possible complications such as injury to the facial nerve, jugular bulb, internal carotid artery and entrance into the mandibular fossa are discussed. Safeguards against them are mentioned. The lining of the eustachian tube is curetted. Occasionally when eustachian tube suppuration continues in spite of this procedure a third operation is carried out in which the eustachian tube is curetted and then filled with a strip of temporal muscle after the method of Wittmack.

Foci of suppuration in the upper part of the middle ear and the mastoid part of radical mastoidectomy cavities are reached by an incision along the anterior superior portion of the external auditory meatus which extends upward just in front of the anterior part of the helix. Skin and periosteum are elevated. The diseased areas of the bone are exenterated with curets, gouge or burr. Extensive surgery of the

petrous portion of the temporal bone is possible through this incision as is also surgery of the mastoid tip although this is much more easily approached by the postauricular route.

Possible complications such as injury to an already exposed dura mater are discussed. Postoperative care of the patient including the use of a widely bacteriostatic compound containing penicillin, favaone, phenoxetol and urea is discussed.

The author offers a series of 15 cases in which he reports practically no postoperative discomfort.

WILLIAM K. WEINER, M.D.

### MOUTH

**Tumors of Salivary-Gland Origin** GRANTLEY W. TAYLOR and GERALD G. GARCKLOW, *N. England J. M.* 1948, 35: 766.

The authors summarize their experience with tumors of salivary-gland origin observed at the Massachusetts General Hospital, Boston, from 1930 to 1941 inclusive and at the Pondville State Cancer Hospital, from 1927 to 1941 inclusive.

**Diagnosis.** Usually the patient presents a symptomless tumor in the submaxillary or parotid region, which is discovered accidentally or because some fullness or swelling is noted.

The essential differences between carcinoma and mixed tumor are summarized as follows:

	Mixed tumor	Carcinoma
Median age of patients	30 to 40 years	50 to 60 years
Median duration of tumor	More than 3 years	Less than 1 year
Tumor of hard consistency	30 per cent	80 per cent
Movable tumor	80 per cent	15 per cent
Enlargement of cervical lymph nodes	3 per cent	47 per cent
Primary facial nerve palsy	0 per cent	25 per cent
Remote metastases	0 per cent	25 per cent

It is evident from these data that in many cases the diagnosis on clinical evidence is ambiguous and that exploration must be done. At the time of operation the discovery of lack of definition of the limits of the tumor, the persistence of fixation as the operation progresses and the apparent implication of the branches of the facial nerve in the tumor itself all argue for the probable diagnosis of cancer. In cases of doubt it is necessary to resort to immediate pathological examination.

**Treatment of mixed tumor.** Simple enucleation of these tumors destroys the best chance of effecting a cure. A radical excision of the gland with visualization and protection of the facial nerve (Adson-Ott operation) gave the best results. Eighty-five patients with primary tumors were treated by surgery of

these 8 developed recurrences and 6 had some facial paralysis. Of 19 patients with recurrent tumors submitted to operation 3 had already suffered injury to the facial nerve. Four patients with secondary tumors developed later recurrence and an additional patient suffered facial nerve injury. Fifteen primary tumors and 10 recurrent tumors were treated by the Adson-Ott operation. There were no recurrences among the patients with primary tumors, but there were 3 recurrences and 1 case of facial paralysis among the recurrent cases. Those patients with local recurrences were successfully treated by second or third operations.

The treatment of carcinoma is unsatisfactory and the method of treatment depends upon the stage of the disease. In early cases recognized by the pathologist and not the surgeon nothing more is done if the Adson-Ott operation has been performed. If carcinoma is recognized at surgery the Adson-Ott operation is indicated or if the facial nerve is involved, more radical measures combined with a radical neck dissection are indicated.

Tumors presenting wide local fixation, inoperable metastasis, or remote dissemination when first seen are treated by surgery or roentgen therapy or both as indicated.

A 12.5 per cent rate of cure was all that could be effected in the 40 patients who were operated on.

Radiation was not an effective treatment for carcinoma.

EDWARD R. DOWDGEY, M.D.

## NECK

**Studies of the Thyroid Gland of Parturients and Newborn Infants in Southern Finland (Helsinki)** VILHO HILTIEMAA. *Acta obst. gyn. scand.* 1948 28 Supp. 1

For the purpose of studying the goiter situation among mothers and newborn infants in southern Finland, 1,000 consecutive parturients and their 1,015 children (15 twin pregnancies) were examined. The material also includes 8 thyroids of mothers who died during delivery and 47 thyroids of infants who were examined after death.

Among 1,000 parturients goiter was found in 141 cases (14.1%) and 121 patients (85.8% of the 141 cases) were cognizant of their thyroid enlargement. The goiters were small or medium sized. In 11 cases (7.8%) the goiter had first appeared during a pregnancy and in 39 cases (27.7%) a pre-existing goiter was further enlarged during pregnancy. Pressure symptoms in the neck were present in 35 cases (24.8%) and were mild in degree. There was a family history of goiter in 48.9% of the goitrous mothers as compared to 14 per cent of the nongoitrous mothers. Thirty-nine per cent of the goitrous mothers had lived for a long time in the regions where goiter is most prevalent in Finland.

With the advance of age and an increase in the number of deliveries goiter and nodules of the thyroid gland appeared more frequently. Palpable nodules of the thyroid gland were present in 23.4% of

the 1,000 parturients. The rate of incidence of nodules was 64.5 per cent in the cases of goiter and 16.6 per cent in thyroid of normal size. Thyrotoxicosis was found in 9.4 per cent of the goitrous mothers. In about half of the cases pregnancy aggravated the symptoms and in one case improvement was observed.

Prior to admission to the obstetric clinic, 13 mothers had been submitted to operation for goiter: 11 because of thyrotoxicosis, 1 mother because of pressure symptoms and 1 solely for cosmetic reasons.

Postmortem examinations were carried out in 8 of the mothers. There were 4 definite cases of goiter, 2 borderline cases and 2 thyroids of normal size. Nodules were noted in all of the goiter cases, in one borderline case and in one of the two normal sized glands. Histologically there was evidence of hyperfunction in half of the 8 cases.

Among the 1,015 newborn there were 139 cases of goiter, the goiters generally being small. Symptoms that have been reported in connection with severe endemic goiter such as thyrotoxic constitutional weakness, shortness of stature, subnormal weight, or congenital cardiac disease were not noted in the author's series. There was a 25 per cent incidence of goiter among 23 full term infants that came to autopsy. The histologic picture in these infants was characterized by small follicles and an abundance of epithelium, follicles of medium size were also found. The epithelium was cuboidal or cylindrical. There was but little colloid. The histologic picture was qualitatively the same in the congenital goiter as that of normal sized thyroids.

Congenital goiter occurred in 35 (24.5%) of the infants of the goitrous mothers and in 104 (11.9%) of the infants of the nongoitrous mothers.

From the obstetrical point of view goiter caused no complications in the mother or in the infant.

EARL O. LATIMER, M.D.

**Chronic Thyroiditis.** SAMUEL F. MARSHALL, WILLIAM A. MEISSNER, and DELBERT C. SMITH. *N. England J. Med.* 1948, 238 758.

Chronic thyroiditis as evidenced by degenerative and fibrotic changes in the thyroid gland is not a common disease. Clinically it is important to recognize this condition because its firmness, adherence, and increase in size may be mistaken for a malignant condition of the thyroid.

This report from the Labey Clinic covers an 18 year period during which 187 cases of thyroiditis were encountered in the pathological examination of the specimens from approximately 25,000 patients requiring thyroidectomy. This represents an incidence of 0.75 per cent.

The diagnosis can be made clinically at times but too frequently biopsy or resection of the lobe is necessary for a diagnosis. A correct preoperative diagnosis of thyroiditis in the group of 187 cases was made in only 44 patients or 23 per cent. Operation is demanded when even the slightest suspicion of a malignant lesion exists and progressive enlargement

or constrictive symptoms occurring in a previously clinically recognized thyroiditis may also require surgical interference at some time after the initial diagnosis has been established.

The authors divided their cases into three groups that could be distinguished clinically and pathologically.

Group I consisted of 41 glands showing a reaction that appeared to be due to infection. It is well known that acute infections of the thyroid occur but as such glands are not removed surgically no such cases are in this series. However 18 glands showing subacute inflammatory changes were encountered. There was moderate fibrosis with numerous inflammatory cells chiefly polymorphonuclear cells often centered in acini. Such acini usually showed degeneration and spillage of colloid with some foreign body giant cell reaction.

In the chronic stage as seen in 18 other cases the polymorphonuclear leukocytes had largely disappeared but numerous foreign body giant cells reacting to colloid were still present. Also scattered throughout the stroma were numerous lymphocytes and plasma cells.

The remaining cases in this group represented the healed stage in which fibrotic changes were predominant. Foreign-body giant cells were usually absent and other inflammatory cells were few in number.

In not one of the stages in this group were epithelial changes characteristic, the remaining epithelium was normal. Grossly all these glands were firm, fibrotic, and often gray or white. The capsules in most specimens were adherent to both the thyroid and adjacent structure.

Group II was composed of 78 thyroid glands which were generally designated as Hashimoto's stromas or struma lymphomatosa. Stromal infiltration with lymphocytes and the formation of numerous secondary lymph follicles. The specimens also showed atrophy and marked acidophilia of the epithelium. Grossly the specimens averaged 100 gm. for two lobes and had a rubbery consistency. The changes were diffuse and homogeneous. The capsules were preserved with no suggestion of adherence.

Group III consisted of a conglomerate group including thyroiditis from several causes. Grossly the specimens showed little that was characteristic. Microscopically they showed the basic stromal and epithelial changes common to all injuries of the thyroid gland, but the changes were so mild that a further classification was not possible. This group was simply designated "chronic thyroiditis nonspecific" and included 68 cases.

Symptoms of all these patients were more or less similar. Goiter or enlargement of the neck was the most common complaint. Local symptoms as pressure, breathing difficulties, choking sensation and difficulty in swallowing, were less common. Neck discomfort was outstanding in the cases of infection thyroiditis (Group I). The average duration of symptoms was a year.

Diagnosis is established by an increased size of the gland, which is bilateral and symmetrical (occasionally Riedel's struma is unilateral). The anatomic outline is maintained. In Riedel's struma the firmness is marked and adherence to surrounding structures is noted. Struma lymphomatosa is firm, but more elastic, and is not adherent to the surrounding structures. Frequently the differentiation from cancer can be made clinically but at times biopsy or resection will have to be performed.

Treatment is often unnecessary when the diagnosis can be made but the patients should be observed for subsequent compression of the trachea.

Partial resection or resection of the isthmus is the treatment of choice when tracheal constriction is to be relieved.

Radical removal of the gland is to be avoided lest the parathyroids or recurrent laryngeal nerves be damaged when the gland is indurated (Group I).

In struma lymphomatosa (Group II), a partial bilateral thyroidectomy is the best procedure.

In Group III a resection of the isthmus usually suffices.

Most of these patients need desiccated thyroid postoperatively. EDWARD R. DOUGLASS, M.D.

Notes on Twenty Year Observations of Goiter in the Surgical Clinic of Geneva (Remarques sur 20 années d'observations de goitres à la clinique chirurgicale de Genève) EUGÈNE WITKO. *Ann. chir. etc.*, 1943, 5: 60.

The present article is based on a study of 594 patients with goiter, 556 of whom were operated upon. The total number of surgical interventions was 592.

Of the 594 patients 483 (81.3%) were women. The youngest patient was 13 and the oldest was 85 years of age. The outcome (592 operations) was fatal in 19 cases, a mortality of 4.9 per cent. Sixty-two per cent of fatalities were among patients with hyperthyroidism and 38 per cent were among patients with nontoxic goiter. In the last 10 years the mortality fell to 3.7 per cent. Sometimes the ligation of one or several thyroid arteries preceded the subtotal thyroidectomy in patients with a high metabolic rate.

Of the 594 patients 308 (51.8%) presented clinical signs of hyperthyroidism.

In Geneva, the relative incidence of hyperthyroidism (30.1%) is higher than in other parts of Switzerland where the incidence is from 4 to 12 per cent. In 1 case out of 6 the clinical symptoms, the metabolic rate and the microscopic picture correspond, one to another. Such contradictions may be explained by the fact that in some instances the patients cease producing thyroxine, because of the secretion of an unknown substance by the organism. This substance probably has an effect similar to that of thiocyanate on goiters, or allolxin on hypoglycemia. Moreover, in some cases metabolic disturbances may be created by an unrecognized compression of the respiratory tract. In such cases a titration of iodine in the blood may establish the correct diagnosis.

JOSEPH K. NARAT, M.D.

# SURGERY OF THE HEAD AND NECK

A New Method of Transverse Pharyngotomy A.  
Réthi. *J Lar Otol.*, Lond. 1943, 62 440.

The author states that transverse pharyngotomy is indicated whenever it is necessary to inspect the mesopharynx or hypopharynx, and for the removal of tumors which are inaccessible or inoperable through the mouth such as a lingual thyroid. The disadvantages of subhyoid or of suprahyoid pharyngotomy are that the area on the other side of the hyoid bone cannot be readily visualized also the sutures tend to pull out because of muscle strain inspiratory strain and cough frequently resulting in a downward displacement of the larynx with danger of asphyxiation pneumonia.

Réthi's method of transverse pharyngotomy does not have any of these disadvantages. It is done under local anesthesia with preliminary inferior tracheotomy. A transverse incision is made along the hyoid bone and the platysma muscle is severed the hyoid bone is uncovered the submandibular gland and the hypoglossal nerve are pushed upward 1 cm. above the hyoid margin, the strap muscles are severed but only below the body of the hyoid bone the thyrohyoid ligament is cut and the pharyngeal mucosa is exposed but not opened above the hyoid the hyoglossus and constrictor muscles adherent to the greater cornu are severed, the tendon of the digastric and stylohyoid muscles are disconnected from the periosteum and the pharyngeal mucosa is exposed. From these points vertical incisions are made connecting with the lateral boundaries of the lower incision the hyoid bone is sawed through in each incision the pharyngeal mucosa is opened along the entire line of these incisions. After the intra-pharyngeal operation the mucosa is sutured with

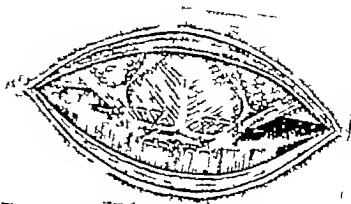


Fig 1 (Réthi) Muscle and bone suture. Greater cornua fastened toward larynx by unsevered soft parts. The strong tongue muscles have been left in their attachment to hyoid bone. The bone suture prevents wound from separation.

fine catgut the hyoid bone is united with wire the thyrohyoid ligament is sutured with catgut, as are the muscles of the tongue and the strap muscles and the skin is closed with clips. Thin glass tube drains are placed under the muscles on both sides, and 2 days later they are replaced with gauze strips. Uneventful primary union almost always occurs.

Two cases of lingual thyroid are presented. One patient was operated upon by the new method to show the difference in the postoperative course. The method of preventing blood from entering the larynx during the operation is described. A tampon is anchored in the larynx and pulled down into it by a double silk thread coming out through the tracheotomy. A Bellocque sound is used in introducing the thread.

WILLIAM K. WRIGHT M.D

# SURGERY OF THE NERVOUS SYSTEM

## BRAIN AND ITS COVERINGS CRANIAL NERVES

Lymphatic Connections of the Subarachnoid Space. E. J. FIELDS and J. B. BRIDGLEY *Brit. M. J.* 1918, 67

The authors present an experimental study of lymphatic connections of the subarachnoid space with special reference to the pathogenesis of poliomyelitis. Particles of India ink introduced into the cranial subarachnoid space of the living rabbit tend to accumulate at certain outflow points in the cervical and lumbar regions of the spinal cord.

The prevertebral lymph nodes are considered to be the regional nodes for the spinal arachnoid space. In the rabbit, the authors show that particulate matter introduced anywhere in the subarachnoid space accumulates largely in the region of the lumbosacral root ganglia in from 6 to 12 hours. Lesser amounts collect in the cranial region along the sheaths of the olfactory filaments and through the jugular foramen. In 24 hours the India ink is cleared from the subarachnoid space, discounting that small amount taken by phagocytosis.

In other experiments the lymphatic pathways were filled in a retrograde manner from the mesenteric and prevertebral lymph nodes after preliminary ligation of the thoracic duct. According to the authors, the possibility of retrograde passage of the polio virus to the lumbar region of the spinal cord must be considered. Results of experimental poliomyelitis are discussed in relation to anatomical observations of the lymphatic pathways from the subarachnoid space in the rabbit.

JOHN L. BELL, M.D.

The Treatment of Subdural Hematoma (Zur Behandlung des subduralen Hämatoms). P. SÖDERBERG. *Pharmaz. Zeit. und. Woch.* 1918, 73, 85.

The author states that during the past few years he has found cerebral arteriography with per-abrodil to be of great value in the diagnosis of subdural hemorrhages as well as of brain tumors. He points out that practically one-third of all cases of subdural hematoma are bilateral and that arteriography or trephination should be performed in all doubtful cases.

The advantages and the disadvantages of removal of the membrane of a chronic subdural hemorrhage are discussed. It is emphasized that the important factor is the re-expansion of the brain after the clot has been removed and that extirpation of the membrane is not essential and may be even harmful. In those cases in which expansion of the hemisphere does not occur there is frequently a terminal central hyperthermia of 40 degrees or more which occurs about 8 to 10 days postoperatively. To prevent this, novocain cervical sympathetic block is advocated by the author.

A case is presented to illustrate this valuable aid in the treatment of such patients. A 45 year old man had suffered a fall 4 months previous to admission to the hospital and, during the 14 days prior to being seen by the author had developed aphasia, right hemiparesis, disorientation and unconsciousness. There was a dilated left pupil. Arteriography confirmed the diagnosis of a left subdural hematoma. A large osteoplastic flap was turned and the hematoma was evacuated the membrane being left *in situ*. Immediately after the operation the patient was able to talk in monosyllables, but lay in bed staring directly ahead of him without movement of his extremities. His condition did not further improve and he developed a central hyperthermia. Another x-ray examination after operation showed a layer of air over the left hemisphere, since re-expansion of the brain had not occurred. All attempts made to inflate the hemisphere by the rectal, subcutaneous and intravenous introduction of saline solution were of no avail. The author quotes Coleman as saying that the failure of re-expansion of the brain is the most severe complication observed in these cases.

The clinical syndrome of central hyperthermia and constant stare suggested a disturbance of the central regulating mechanism of the diencephalon. The author states that he had seen similar patterns in cerebral endarteritis obliterans and was cognizant of the part played by the autonomic nervous system in relation to it. On the seventh postoperative day he performed a successful cervical sympathetic block with novocain. The following morning the patient greeted him for the first time, the hyperthermia vanished and the motor power in the paretic side began to return. Along with the clinical improvement there was a disappearance of the layer of air previously noted. The patient made an uneventful recovery.

The author is convinced that the improvement in the patient's course followed the procain block of the cervical sympathetic system, which resulted in rapid and complete re-expansion of the left hemisphere. He does not think that this is merely a vasomotor effect, but from his observations on other cases he believes that in addition to the vasomotor component there is a direct response of the central regulatory mechanisms which exercise their effect on the nuclei of the diencephalon and possibly exert some influence on the production of the cerebrospinal fluid.

ROBERT C. SCHENKEL, M.D.

## SPINAL CORD AND ITS COVERINGS

A Case of Vertebral Hemangioma with Paraplegia (Su di un caso di emangioma vert. brale con paraplegia). PARIDE STEFANELLI. *A. n. Id. esp. Agnesi*, 1918-17, 1, 375.

A 17-year-old boy suffered an attack of heaviness and numbness of the lower extremities which lasted

about a month. Two years later the symptoms reappeared and in the course of 2 months eventuated in symptoms of spastic paraparesis with accentuated reflexes and a bilateral hypaesthesia extending downward from the level of the seventh dorsal segment and becoming ever more pronounced distally. There was some tenderness in the paravertebral fossa especially on the right side. The muscles were not wasted and there was no other evidence of trophic disturbance. Spinal puncture and examination of the spinal fluid obtained disclosed findings consistent with block of the spinal canal which neurologic study placed between the fifth and sixth dorsal vertebrae (seventh medullary segment). Roentgenologic examination placed in evidence the typical longitudinal striations of alternating osteoporosis and eburation in the fifth dorsal vertebra characteristic of vertebral hemangioma. The diagnosis was massive extramedullary compression at the level of the seventh medullary segment caused in all probability by vertebral angioma.

The operation of laminectomy resulted in severe bleeding which was especially severe at the level of the fifth dorsal vertebra and on the right side. The laminectomy was completed first on the fourth and sixth dorsal vertebrae and then on the fifth vertebra the bleeding being controlled by electrocoagulation and wax insertions. Here the tumor was found to be attached to the vertebral peduncle on the right side and the whole was removed together with the peduncle itself. The compression of the cord was caused by the tumor which had pushed the cord forward and to the left.

Histologic examination disclosed the nature of the tumor as a capillary angioma. Forty five days later the patient was able to walk about unassisted and 5 months later the neurologic examination was completely negative. Before the patient was discharged 5,000 roentgens were given over the involved vertebra. The patient was seen 5 years later and at this time the lesion was still neurologically silent however roentgen examination disclosed that the lesion in the body of the vertebra had made further progress. The body of the vertebra was now dilated—blown up like a bottle—and the intervertebral space between the fourth and fifth dorsal vertebrae was narrowed probably as a result of the operation.

The author believes that in these cases complicated by a paraplegia surgical intervention is indicated and that roentgen therapy should be reserved for the uncomplicated cases.

JOHN W. BRENNAN, M.D.

#### PERIPHERAL NERVES

*The Pathology of Peripheral Nerve Injuries.* WOODS HAYMAKER. *Mil Surgeon* 1948, 102 448.

The author does not believe that it is wise to perform immediate definitive end-to-end anastomoses of nerves which have been severed in gunshot wounds. He maintains that the contusion is greater than is at first apparent and that the contused zone of the

nerve is well demarcated from the intact zone about 3 weeks after the injury. Further arguments for delaying suture 3 weeks are that at this time the epineurium in the region of the injury has thickened and gained in tensile strength so that it holds a suture more adequately and the Schwann tubules of the distal segment are wide open to receive regenerating fibers. In a severed nerve the newly formed axons grow rapidly down the Schwann tubules. When they enter the contused region of the proximal segment in which the fascicular arrangement has been lost and in which the connective tissue is still in the process of forming a dense scar the fibers become grouped together in aberrant fascicles and twist about, forming a large bulbous mass the proximal neuroma. Since the nerve still has remarkable regenerative powers weeks after the injury the author does not believe that downward growth should be hampered by scar tissue which could be resected after the extent of contusion has declared itself. After a period of 3 months the Schwann tubules begin to lose their patency and downgrowth of new axons becomes increasingly more difficult. When regenerating axons reach a muscle which has been denervated for only a short period of time they re-enter the motor end-plates and appear as normal end-plates. After several months however the muscle fibers atrophy and become surrounded with connective tissue plugging the Schwann tubules and making downgrowth to the motor end plate difficult.

DANIEL ROOS, M.D.

*Observations on Injuries of the Radial Nerve Due to Gunshot Wounds and Other Causes.* S. SPOONER. *Lancet Austral N Zealand J Surg*, 1948 17 253.

The author's article is concerned with lesions of the radial nerve and is based on the personal records of 63 patients who were treated in the 115th Australian General Hospital during the period from 1941 to 1945. An accurate follow-up extending over a period of 4 years was possible and the follow-up examinations of all patients with radial nerve injuries were made by the same observer.

A detailed description of each case is presented. Nerves known to be severed were repaired in cases in which this was possible. Immediate local conditions being favorable while partial or complete lesions in which the anatomical condition of the nerve was not known were given every opportunity to recover spontaneously before resorting to exploration. In general exploration was not contemplated within 6 months of the injury. It was the experience of this author as well as others that the majority of the nerve lesions recover spontaneously and show some signs of recovery within 6 months. In 45 patients the nerve recovered spontaneously without exploration.

In 3 patients a severed nerve was sutured immediately after the injury. In 15 patients nerves were explored and of these 3 were in the state of continuity not requiring repair, 5 were sutured, 2 were grafted and 6 were subjected to tendon transplantation owing to irreparable damage to the nerve.

The 2 nerves which had been grafted and 2 of the 5 which had been sutured did not recover and ultimately the patients required tendon transplantations.

The end results in the case of the 17 explored nerves were as follows: sutured with recovery 5, in continuity with recovery 3, and irreparably damaged 10. There was a high incidence of irreparable lesions due to gunshot wounds which resulted in a fracture of the humerus.

The relative merits of early and late exploration of clinically complete lesions is discussed. Evidence is presented which lends emphasis to the belief that the majority of injured nerves will recover spontaneously if treated conservatively, and that if early exploration is undertaken it is advisable to preserve the continuity of the nerve, regardless of the pathological changes present until it has been given an opportunity to recover spontaneously. While early exploration (by permitting prompt suture) is of value in cases of complete severance of the nerve, it is urged strongly that nerves found in continuity should not be disturbed.

A delay of 6 months before suture is not necessarily prejudicial to the end result. The time element is only one of many variable factors affecting the restoration of function following suture and further investigation is required to evaluate correctly the influence of this factor.

Attention is directed to the dangers of too prolonged immobilization and the value of physiotherapy is stressed.

When axones have been interrupted significance is attached to the initial delay, which has been defined as the time between the injury and the entry of the regenerating axones into that portion of the nerve distal to the site of injury. (The time taken for the completion of those muscular changes upon which the restoration of voluntary contraction depends has also been included.)

A method for calculating this delay has been described.

a. The duration of the initial delay was a measure of the severity of the nerve lesion.

b. The initial delay was related to the time taken by the regenerating axones to reinnervate the entire motor field subsequent to the onset of recovery. In general long and short initial delays were associated with long and short periods of reinnervation.

c. An initial delay of up to 10 weeks followed the mildest cases of axonotomies, which were usually due to the simplest types of injury such as those associated with simple fractures of the humerus. More severe injuries, such as those due to gunshot wounds associated with fractures of the humerus, infection, and extensive scarring were followed by an initial delay of approximately 4 months. This was also the usual period of delay following suture. It is, however, difficult to differentiate between simple and severe nerve lesions, since the nature and severity of the causative injury was not a reliable guide.

The maximal period intervening between the injury and the onset of spontaneous recovery (latent

period) which proceeded to completion was 10 months. In the majority of nerves regenerating spontaneously however recovery had appeared by the end of 6 months.

The probable date of recovery (spontaneous or after suture) can be calculated from a knowledge of (1) the presumed initial delay (2) the level of the lesion, and (3) the rate of regeneration. Information relating to these three factors has been provided.

The approximate time when voluntary contraction may be expected in the last muscle to be reinnervated may be calculated by adding from 11 to 13 weeks, according to the type and severity of the nerve lesion, to the date of the onset of recovery in the first muscle to recover.

The regeneration of motor fibers was not always accompanied by a corresponding recovery of sensory function.

HOWARD H. LARSEN, M.D.

Experimental Contribution to the Problem of Reconstruction of Peripheral Nerves After Traumatic Lesions (Experimenteller Beitrag zum Problem der Wiederherstellung von traumatischen Läsionen peripherer Nerven) *MASSACHUSETTS JOURNAL OF MEDICINE* 94:5, 15, 23.

In a review of degenerative and regenerative processes in the nerves following traumas, the author describes the customary methods of treatment of nerve lesions. If an end-to-end union is impossible, autotransplantation must be taken into consideration. No cuffs are employed because they interfere with vascularization of the nerve endings.

In the author's experiments on rabbits the employment of woman's hair as a suture material proved very reliable because it has a sufficient tensile strength and produces hardly any reaction. The author advocates the use of stiff cuffs made of plexiglass and filled with autogenous plasma because they prevent formation of scar tissue which may interfere with the growth of axial cylinders, and because the autogenous plasma with its fibrin coagulum has a structure propitious to advance of the axial cylinders.

Contrary to the opinion of American writers, the author does not believe that the plasma clot is able to replace a nerve suture. The stiff cuff prevents a compression of the suture line by a callus of fibrous cicatricial tissue. Such compression may occur even if the nerve suture line is made in intact muscle.

In the author's experiments on 20 animals, necrosis of the nerve endings surrounded by a cuff did not take place in a single case. Capillary beds within the nerve provide sufficient circulation.

JOSEPH K. NARAT, M.D.

#### MISCELLANEOUS

Discussion on the Surgical Treatment of Hypertension. ROBERT PLATT, D. W. C. NORTHFIELD, F. A. MARRAS, A. L. BORD, and Others. *Proc. R. Soc. M.* Lond., 94:5, 41, 359.

In the present discussion PLATT states that sympathectomy for hypertension is formulaic and on

physiological procedure that the results on the whole are disappointing and that the claims of surgeons must be accepted only after close and careful scrutiny but that in some cases which are quite unpredictable a significant, lasting and beneficial reduction in blood pressure is achieved.

The cause of human essential hypertension is still unknown and therefore a purely physiological attack cannot be designed as yet. The author favors renal origin as the cause of essential hypertension. The subsequent damage to the cardiovascular system (and most hypertensive patients eventually die of cardiac failure or cerebrovascular accidents) is serious and therefore there may be justification in using nonphysiological means to reduce the blood pressure if they can be shown to have no serious untoward consequences.

Subsequent discussion was with reference to the extent of the sympathectomy in order to obtain adequate denervation of the splanchnic area.

The importance of very careful analysis in all series of cases was pointed out, in view of the variability of blood pressure levels in patients with essential hypertension in addition to the fact that hypertension may not carry the increased immediate risk to life unless diastolic levels reach 115 to 120. Furthermore the known fact that women tolerate hypertension better than men (and a symptomless hypertension may persist for years without progression) also must be taken into account in an analysis of any series of operative cases.

This author believes that if only cases of malignant hypertension were included in a survey and if operation was successful in 10 to 20 per cent of patients, the results would be significant whereas one would be skeptical of claims of improvement even in 70 per cent of mild cases of labial hypertension.

In the author's series of 38 cases the majority of people over 50 years of age were rejected as well as those with poor renal function, advanced cardiac changes or serious cerebral complications. Operation has not been recommended in patients with diastolic levels of 110 or below. An effort has been made to assess the prognosis without operation before any recommendations have been made.

Three operative deaths were reported. The results were good in 4 cases and worthwhile in 8 cases. Failure occurred in 9 cases. Other cases were too recent or they had not had a complete operative course.

In conclusion the author believes that sympathectomy might alter the prognosis of severe hypertension favorably in 25 to 50 per cent of the cases. The question as to the extent of the sympathectomy required has not been determined with certainty and further studies are being conducted in this regard.

NORMAN reviewed 46 cases of severe hypertension at the London Hospital. All of these patients had undergone sympathectomy. The group was highly selected and operation was carried out only on patients in whom the medical prognosis was known to be bad. The majority of patients had

malignant hypertension or renal disease with severe hypertension. A careful preoperative medical survey was carried out in all cases and particular attention was paid to the fundi. Based upon this criterion 80 per cent showed evidence of malignant hypertension although it was believed that no view of the preoperative duration of the disease the malignant phase had more recently supervened upon the benign phase. Normal fundi were present in only 4 out of 46 cases.

The Adson (subdiaphragmatic) approach was employed in the first 10 patients of this series with 2 operative deaths. In the remaining 36 patients the Smithwick operation was carried out with 6 deaths.

A detailed analysis of these cases is then given with reference to the changes in the fundi, the presence of cerebral symptoms, headache, impaired renal function and the postoperative results with particular reference to these factors.

Twelve males with essential hypertension survived bilateral operation and in 8 the blood pressure was not appreciably altered although survival occurred for periods of over 2 years and 4 years. In 3 patients there was a slight to moderate lowering and in one patient the blood pressure had been at normal for 4 months. Seventeen females survived the operation. In 6 of these the blood pressure was unchanged. In 5 there was slight to moderate lowering and in the remaining 6 marked improvement was observed.

In the group with renal hypertension the blood pressure improved in 3 cases and was unaltered in 4. Patients with headaches were greatly benefited. The optic fundi were usually dramatically improved following operation.

The operative procedure consists in removal of the sympathetic chain from the ninth dorsal to the second lumbar ganglion inclusive in addition to removal of the splanchnic nerve in the same area. A further description of operative technique and anesthesia is given.

The necessity of subjecting surgical methods to careful testing under controlled conditions is pointed out by D'ARREY who has adopted the following criteria: (1) retinal hemorrhages and exudates with retinal edema or papilledema; (2) a history of hypertensive encephalopathic incidents; (3) a fixed high diastolic pressure around 150. All cases were included on one or more of these grounds.

It is contended that operation should be performed in every case of the worst form of hypertension if severe kidney damage has not yet occurred. The operative technique employed is essentially of the Smithwick type with excision from the eighth thoracic to the first lumbar ganglion at least on each side and with excision of the celiac ganglion and the greater lesser and least splanchnic nerves as high as possible. Eight cases are reported in which marked improvement was observed in the fundi in all but one patient who was almost blind at the time of operation. This patient died 11 weeks after the second operation. A material drop in blood pressure was recorded in 5 of the 8 patients.



BOYD expressed the belief that the operative technique for complete denervation of the splanchnic area should include removal of the sympathetic ganglia as high as the third dorsal and to include the third lumbar ganglion below. The procedure is carried out with two incisions. The twelfth dorsal to the third lumbar ganglion are removed through an oblique muscle-cutting incision in line of the twelfth rib part of which is resected. The upper segment and thoracic splanchnics are removed transpleurally access being gained by resection of the eighth rib. Subsequent studies to determine the completeness of the operation have been carried out by mapping cutaneous areas of anhidrosis by means of an extremely sensitive electrodermatometer designed by A. H. Ratcliffe.

WRIGHT suggested that the choice of operation is very difficult to make but a useful clinical experiment would be to reoperate on some of the Adson and Peet operative failures remove the ganglionic chain trans thoracically, and endeavor to obtain further facts and it is quite possible that cervical sympathectomy obtained by the trans thoracic operation might lessen the risk of cerebral and ocular hemorrhage.

WILSON pointed out that there are many instances in which the blood pressure level does not fall appreciably following operation, but that the hypertension changes in quality even though quantitatively it is unaltered. The malignant character of the disease which leads to retinal changes, increased intracranial pressure, renal vascular lesion and left ventricular failure may be modified so that the hypertension becomes relatively benign. Unfortunately this alleviation may not be of long duration although in women the results are much more impressive.

ORRIDGE made a point with regard to the severe drop in blood pressure during the operative procedure. He believes that this is due to a increased pressure gradient to the brachial artery due to spasm of arteries proximal to the flow rather than to a fall in the head of pressure at the center. Intravenous injection of 200 mgm. of procaine will

relax vascular spasm and produce a rise in brachial blood pressure in 2 or 3 minutes. This rise could not be reproduced in a healthy patient under anesthesia, the injection resulting only in a slight tachycardia but without rise in pressure.

HOWARD A. BROWN, M.D.

**Effects of Novocainization of the Contralateral Stellate Ganglion on Pain in the Limbs and Amputation Stumps** (Les effets de la novocainisation stellate contralatérale sur les douleurs des membres et des moignons) A. JUNG, Rev. fr. Par 648 67 72

After paying tribute to Leriche the author discusses the effects of injecting novocain into the stellate ganglion in cases of pain in the extremities. Injection into the ipsilateral ganglion interferes with the peripheral mechanism of pain but contralateral injection affects the central path also. In this way it may be possible to dissociate the peripheral pain from the central element of pain. Injection on the contralateral side produces vasodilatation in the region in which the pain is registered in the brain there is a sympathetic block to the pain registering zone. Unilateral stellate block in Raynaud's disease affecting both hands is said to produce some contralateral effects as measured by temperature studies, although the classical Sjöberg's syndrome is not produced.

Against this background of spread of similar effects to the contralateral side the author contrasts dissimilar effects on a limb in which one stellate ganglion or the other is injected with novocain. Nine amputees were injected. Ipsilateral injection caused the phantom limb to feel longer whereas contralateral injection caused it to feel shorter. Three other cases in which the upper limbs were bilaterally amputated produced the same picture elongation on the ipsilateral, and shortening on the contralateral side from the operation. Five other cases of phantom limb are mentioned in which benefit was obtained from contralateral stellate ganglion injection.

There are two references to the French literature.

ARISTIDE VAN BROUCKHED, M.D.

# SURGERY OF THE THORAX

## CHEST WALL AND BREAST

**Is Chronic Cystic Mastitis a Precancerous Lesion?**  
Ten Year Follow Up Study of 26 Cases. H. LESTER REED *Arch. Surg.* 1948, 56 338

Three types of chronic cystic mastitis can be distinguished histologically (1) simple chronic cystic mastitis (2) chronic cystic mastitis with papillary proliferation and (3) chronic cystic mastitis with atypia.

There is no unanimity of opinion concerning the nature of chronic cystic mastitis its relation to cancer or the best method of treatment. The treatment of the condition should be governed by the histologic type of the lesion. Simple chronic cystic mastitis which is present in more than 80 per cent of cases is treated by local excision of the involved area only and regular follow-up examinations of the patients are regarded as unnecessary. Chronic cystic mastitis with papillary proliferation (4 per cent) is also treated by local removal but the patients are advised to report for clinical examination every 6 months after the operation. Chronic cystic mastitis with atypia (15 per cent) is treated by simple mastectomy with regular postoperative follow-up examinations.

Twenty-six patients with chronic cystic mastitis of various types were treated according to these principles and were followed for from 10 to 17 years after operation. Cancer of the breast did not develop in a single instance.

SAMUEL KAHN M D

## TRACHEA, LUNGS, AND PLEURA

**Carcinoma of the Trachea.** CLARENCE W ENOLER.  
*Ann. Otol. Rhinol.*, 1948, 57 419

Any instance of carcinoma of the trachea is worthy of report, in view of the rarity of the condition. The number of cases of primary carcinoma of the trachea hitherto reported is approximately 200. In practically all of the cases reported in the last decade a careful histologic study of the tumors was made yet much confusion remains concerning their exact classification.

The type of lesion about which most confusion exists is that variously designated as cylindroma, basal cell carcinoma, mixed tumor of salivary type, cylindric epithelioma, and adenoma. If these tumors are not of the same type the reported descriptions of them contain striking similarities and it seems to be difficult to recognize any criteria for distinguishing one from the other. It appears that this group of neoplasms although essentially benign may undergo malignant change and must be considered as potentially if not actually malignant. Some distinction, however should be made between this type of questionable or low grade malignancy and the more rapidly developing types. This distinction is essential in evaluating the probable results of treatment.

Since any tumor that grows large enough to obstruct the tracheal airway is incompatible with life early bronchoscopy and radical removal of any tracheal tumor in patients whose symptoms suggest tracheal obstruction is essential. If this were done, cancer of the trachea could be prevented in some cases at least and the results of treatment of frankly malignant tumors would be improved. This belief is strengthened by the fact that, in the majority of cases of carcinoma of the trachea the metastases are only regional.

Two cases are reported one a definite primary carcinoma of the trachea the other so far advanced when first observed that it could not be determined even at autopsy whether the lesion was primary in the trachea or in the esophagus.

SAMUEL KAHN M D

## ESOPHAGUS AND MEDIASTINUM

**Resection of the Thoracic Esophagus for Carcinoma Located Above the Arch of the Aorta; Cervical Esophagogastronomy** JOHN H. GARLOCK, Sr.  
*ibid.* 1948 24 1

The least frequent site for carcinomatous involvement of the esophagus is between the border of the aortic arch and the apex of the chest. In this region the esophagus is in close proximity to the trachea, the great vessels and the vagus and recurrent laryngeal nerves. Local involvement of these adjacent structures frequently results in inoperability. The author describes a procedure used to excise a large tumor in this area with esophagogastric anastomosis. He mentions that stimulation of the vagus nerves may set up the vagovagal reflex which may result in irreversible disturbances of cardiac function. He further suggests that atropine preoperatively may prevent or alleviate this result.

The case report is that of a 46 year old female patient admitted to the Mount Sinai Hospital, New York on December 24, 1946. The duration of her symptoms was 3 months beginning with dysphagia on swallowing solid food. At the time of admission she could swallow only liquids. There had been a weight loss of 15 pounds. Roentgen ray examination revealed a large irregular mass partially obstructing the esophagus at the upper level of the aortic arch. On esophagoscopy a large irregular grayish tumor was seen and biopsy revealed an infiltrating hornifying squamous cell carcinoma. On January 3, 1947 operation was performed. The neck was explored through an oblique incision along the left sternomastoid muscle. It was decided that the tumor was resectable and the wound was closed temporarily. The left seventh rib was removed, the mediastinal pleura opened and a large tumor of the esophagus was found extending from the middle of the arch to 1 inch above the arch of the aorta. It was dissected

free. Through an incision in the diaphragm the cardiac end of the stomach was freed and the whole stomach was mobilized by dividing and ligating the vasa brevia, the left gastrophrenic vessels, and left gastric artery. The gastrosplenic ligament was left attached to the stomach. The esophagus was divided at the cardiac junction and brought up to a supra-aortic position. The esophagus was brought through the reopened neck wound, the esophageal branches of the inferior thyroid artery being preserved. The mobilized stomach was pushed through the apex of the chest and out of the neck without any tension. Multiple silk sutures were placed between stomach and both edges of the mediastinal pleura. The diaphragm and chest were closed and under water drainage was started.

Returning to the cervical wound the esophagus was divided and a two-layer interrupted silk suture anastomosis with the stomach was done. At no time during the procedure was the patient in shock. Late in the morning there was marked cyanosis and respiratory distress, and the patient died very quickly. Complete postmortem did not reveal any cause of death. The author believes the patient's death was caused by physiologic disturbances possibly caused by vagal stimulation. In this case the stomach was mobilized above the apex of the chest without impairment of its vitality. The esophageal branches of the inferior thyroid artery were preserved for blood supply to the esophageal stump.

It is suggested that this procedure may be used for extensive impermeable lye strictures of the thoracic esophagus. ROBERT E. FLOREN, M.D.

**Subtotal Esophagectomy and Esophagogastricostomy for High Intrathoracic Esophageal Lesions.**  
STEWART E. DELLAKY and ALTON OCKENFELS. *Surgery* 94:3 3935

This report is concerned with the author's experiences with the operation of Garlock and of Sweet as applied to lesions of the upper portions of the intrathoracic esophagus. Two cases are reviewed in detail with emphasis on the technical considerations of the operation.

Perhaps the most difficult feature of the operation is the performance of esophagogastric anastomosis at a high level in the chest. If the incision in the thoracic wall is made sufficiently high to facilitate the procedure, difficulty will be encountered in mobilizing the stomach adequately, whereas if the incision is made low enough in the chest to facilitate the latter procedure, the anastomosis becomes difficult. To solve this problem, Garlock opened the chest through the sixth or seventh interspace and then divided the fourth to the eighth or fifth to the ninth ribs posteriorly to form a T-shaped incision in the thoracic wall. Sweet achieved his purpose by entering the chest through the bed of the eighth rib and then divided the seventh, sixth, fifth and fourth ribs paravertebrally.

The authors have altered these approaches somewhat. In their first case the chest was entered through

the bed of the left seventh rib and the sixth and fifth ribs were divided paravertebrally. In the second case the chest was entered through the bed of the left sixth rib, and the fifth rib was divided paravertebrally. Neither of these approaches proved completely satisfactory, for in order to provide adequate exposure for mobilization of the stomach in both it was found desirable to extend the incision across the costal arch anteriorly into the abdomen. This provided an excellent exposure of the lower segment of the esophagus and of the stomach. Although it was well tolerated in both cases, it obviously increased the time and magnitude of the operation.

Ideally the incision should permit adequate exposure low in the chest in order to facilitate mobilization of the stomach and high in the chest to provide ready access for the esophagogastric anastomosis with a minimum of operative trauma. The authors therefore suggest that it may be better to make an incision in the left thoracic wall which begins paravertebrally over the fourth rib, extends caudad to the seventh rib and then curves anteriorly to follow the seventh rib to its costochondral junction. The pleural cavity could then be entered through the bed of the subperiosteally resected seventh or eighth ribs. After it has been determined that the lesion is resectable, especially in malignant cases, and the esophagus is freed from its bed, the stomach can be mobilized through the diaphragm, brought up into the chest and the diaphragm closed around it. The remainder of the operation, that is, the esophagogastric anastomosis, can then be done through a higher level by mobilization of the upper flap of the incision in the thoracic wall and entrance into the pleural cavity through the bed of the subperiosteally resected fourth rib. In this way only one incision is made in the soft parts of the thoracic wall with provision for two levels of exposure.

The details of the operation as performed are outlined. The esophagus is freed by careful blunt and sharp dissection from its bed in the mediastinum. The esophageal vessels from the aorta and bronchial arteries are ligated and divided. The esophagus above the aortic arch is exposed through an opening in the mediastinal pleura behind the left subclavian artery. This permits dissection of the esophagus behind the aortic arch to be carried out from above and below. Once the esophagus has been completely freed from its bed, the phrenic nerve is crushed, and mobilization of the stomach is begun through a radial incision in the diaphragm from the hilus to its costal attachment. The stomach is mobilized by section of the gastrosplenic, gastrosplenic, and gastrophrenic ligaments and the vessels contained in them are carefully taken to preserve the vascular arches along the greater and lesser curvatures. The left gastric artery is severed close to its origin, rather than by multiple division of its branches. The esophagus is then separated from the stomach between clamps and the gastric stoma closed by inverted suture. The esophagus is brought out from under the aortic arch to the left and above the aorta behind the left subclavian ar-

tery The anastomosis is then performed after the stomach is brought up into the chest. It is preferable to bevel the esophageal opening to allow a larger stoma. After the completion of the esophagogastric anastomosis the stomach is attached to the parietal pleura posteriorly with interrupted sutures. The opening in the diaphragm is then closed first by attachment of its edges around the stomach just above the pylorus and then by approximation of the remaining edges. Oxygen is administered during the first 24 hours, and fluids and blood are administered as required. The patient is allowed to drink fluids early. He can usually take a soft diet by the third day and a full diet by the fifth postoperative day. Early ambulation is desirable. HAROLD LAUFMAN, M.D.

### MISCELLANEOUS

#### Pulmonary Valvulotomy for Congenital Pulmonary Stenosis. R. C. Brock. *Brit. M. J.* 1948, 1: 1111

Although cardiac surgery may be said to have begun in 1896 when Rehn successfully sutured a wound of the heart, and has advanced greatly through the intervening years by the work of such people as Gross and Hubbard (patent ductus arteriosus procedure, 1939) Crafoord and Nylin (aortic coarctation resection 1945) and Blalock and Tausig (surgery for pulmonary valvular stenosis 1945) the author points out that comparatively little has been accomplished in directly attacking the structures of the heart. Several attempts have been made in past years to dilate stenosed valves both by mechanical means and by digital manipulation but present surgical thinking in general considers this approach impractical.

The author emphasizes the need for completely investigating the possibilities of direct approach to the heart structures as opposed to the present widely used indirect procedures which bypass stenosed valves. The Blalock method is criticized because the fistulous communication may not grow as the child does and because of the potential danger of the artificially created ductus arteriosus.

Since the best way to assess the state of the cardiac valves is direct examination, a suitable cardioscope is of prime importance. Such an instrument was devised by Allen and Graham (1922). This instrument is inserted into the heart, the blood is displaced and the valves can be inspected directly. Although the pulmonary valve can be approached either through the left pulmonary artery or the left ventricle, the author considers the ventricular route better.

Direct external examination of the heart will help to confirm the diagnosis of pulmonary valvular stenosis. There is a thrill in the stem of the pulmonary artery immediately distal to the valvular stenosis. Often the artery in this site is dilated and forms a thin walled aneurysmal bulge. When a subvalvular stenosis is present, no such localized and characteristic thrill is felt. Rather, the thrill is coarse and is felt over the level of the valves and is present over a greater area.

Three patients presenting the tetralogy of Fallot, aged 11, 18 and 23 years respectively were submitted to operation with a direct valvular approach. In each the valves were first dilated with a valvulotome which was passed through the left ventricle. This divided the stenosed valve. Next a dilating forceps was passed through the valvular lumen and the valve enlarged. Following surgery these patients exhibited marked improvement with regard to their symptoms. Two of the patients however developed vascular complications: one an arterial embolus to the leg and the other a hemiplegia. The fact that these results have been noted after the Blalock procedure is mentioned.

The author concludes that pulmonary valvulotomy is a feasible technique. He does not contend that it should supplant the Blalock method of treating pulmonary stenosis, but rather suggests that the direct approach to cardiac lesions should be more fully investigated. C. FREDERICK KITTLE, M.D.

#### Aortic Pulmonary Anastomosis. WILLIS J. POTTS and STANLEY GIBSON. *J. Am. M. Ass.* 1948 137: 343.

Forty five operations are reported in which the aorta and pulmonary artery were anastomosed for surgical relief of congenital pulmonary stenosis according to the method devised by Potts, Smith, and Gibson in 1946. Seven additional patients underwent exploratory thoracotomy without anastomosis.

The tetralogy of Fallot is by far the most common condition with inadequate pulmonary circulation. This syndrome consists of pulmonary stenosis, interventricular septal defect, overriding of the septal defect by the aorta, and hypertrophy of the right ventricle. Characteristically there is marked cyanosis and clubbing of the fingers and toes. There may be retarded mental development and malnutrition. Physical examination discloses a normal sized or slightly enlarged heart with a systolic murmur audible along the left sternal margin in the second and third left interspaces, sometimes accompanied by a thrill. Roentgenologic study reveals a boot shaped heart and fluoroscopic inspection discloses the absence of pulsations in the hilar regions. In the left anterior oblique position the pulmonary window is unusually clear. The electrocardiogram shows a pronounced right axis deviation. There are varying degrees of polycythemia and diminished arterial oxygen saturation. No apparent correlation exists between the degree of cyanosis, polycythemia, and the patient's limitation of activity.

Once the diagnosis of Fallot's tetralogy is established it is necessary to determine the position of the aortic arch before operation is undertaken. In from 15 to 30 per cent of the cases the arch descends on the right. To perform anastomosis the chest should be entered on the side where the arch lies. This location can usually be determined by inspection of the chest roentgenogram. If not, use of a barium swallow with observation of the aortic indentation on the esophagus will be decisive.

Tricuspid atresia must be differentiated from the tetralogy of Fallot. The physical signs and clinical symptomatology are essentially the same but two important differences distinguish tricuspid atresia: the roentgen silhouette reveals enlargement of the left ventricle and absence of the normal fullness of the right ventricle, and left axis deviation is revealed by the electrocardiogram. Four patients exhibited this syndrome and in 3 an aortopulmonary-artery anastomosis was done with striking improvement in their cardiac status. In the fourth patient no anastomosis could be done because of a rudimentary pulmonary artery.

Skilfully given intratracheal anesthesia is imperative because the narrow margin of safety in these severe grades of anoxemia and the emergencies which arise during cardiac and thoracic surgery demand thorough knowledge and resourcefulness. The child is placed in a lateral position and the incision is made on the side where the aortic arch lies. No sponges are used within the chest but blood is lavaged away with a stream of isotonic saline solution. Considerable variation in size of the pulmonary artery is found, the average artery being from 5 to 8 mm. in diameter. The left pulmonary artery is usually longer than the right and does not break into branches before entering the hilus as does its counterpart. The left pulmonary artery lies fairly near to the aorta and courses in almost the same plane as the aorta whereas the right pulmonary artery lies along the inferior portion of the hilus of the lung and pursues a route almost perpendicular to the aorta. Although some uncertainty was felt about anastomosing the pulmonary artery to an aorta lying at right angles such fears have been unjustified by the uneventful course of 7 patients in whom this was done.

The anastomosis is performed after temporary obliteration of the pulmonary artery by placing a doubled ligature about it. One end of each suture is threaded through the flange on a Potts aortic clamp

so as to insure good approximation of the pulmonary artery to the aorta. The site of the anastomosis is determined by the position of the pulmonary artery although it is usually about 3 cm. distal to the origin of the subclavian. A stoma is made in the aorta and the pulmonary artery and the anastomosis is sutured with over and over continuous 5-0 silk.

Postoperatively an oxygen tent may be needed and penicillin is given routinely. Complications have been few. Severe tracheobronchitis with laryngeal edema occurred in 3 children. Three had a mild tracheobronchitis satisfactorily relieved by steam. In 4 aspirations of fluid, air or both were necessary. Cerebral anoxia in one patient caused total paralysis for 3 days, but recovery was complete. The average length of hospitalization following the operation was 14 days.

Four patients died a mortality of 8.8 per cent. The deaths were due to cerebral thrombosis in 2, post-operative shock and tension pneumothorax (secondary to apical tuberculosis) in 1, and hypothalamic hemorrhage in 1. Seven operations were exploratory because of small pulmonary arteries which made an anastomosis infeasible or because of an Eisenmenger complex. Three of the 7 patients failed to survive thoracotomy.

Of the 41 patients who survived operation, 39 showed great improvement in their condition, being relieved of cyanosis, having gained weight, and being able to live fairly normal lives. Two patients are better but still exhibit slight cyanosis. The anastomotic channels are open in all, this being ascertained by the presence of a faint systolic and diastolic humming murmur. No child was refused surgical treatment if the preoperative diagnosis indicated a pulmonary circulation which might be improved by this procedure. It is appreciated that these children do not have a normal cardiac mechanism and that extra work is added by creation of the artificial ductus arteriosus. C. FREDERICK KITTLE, M.D.

# SURGERY OF THE ABDOMEN

## ABDOMINAL WALL AND PERITONEUM

Mesenteric Vascular Occlusion J D RIVKS, L. H. STRUG and L. M. EASER. *Ann Surg* 1948 127 887

Infarction of the mesenteric vessels which is not associated with the thrombosis incident to local infection or trauma, as in appendicitis peritonitis or operative injury is a very uncommon disease and is usually associated with advanced cardiovascular disease. The mortality is extremely high either because of the state of extremis already present in a patient suffering from severe arrhythmias or congestive heart failure with mural thrombus formation or because the diagnosis and treatment has been too long delayed in other forms of the disease which are not associated with cardiovascular sources. Death from the first cause may be unavoidable but from the second it frequently is not.

Mesenteric vascular occlusion in the beginning may be either arterial or venous in type but thrombosis in one type of vessel is generally followed by involvement of the other so that at a later pathologic examination it is generally impossible to determine in which vessel the process began. The pathophysiologic changes are the same in arterial venous or combined types of occlusion and, depending on the degree of ischemia present and the development of collateral circulation these consist of (1) no changes (2) paralytic ileus with no tissue alteration other than congestion (3) mucosal necrosis (4) ecchymoses into the bowel wall (5) focal or massive hemorrhagic infarction and ultimately (6) perforation. Gas does not tend to accumulate in the involved segment, presumably because the infiltrated bowel wall is incapable of distention. At laparotomy the infarcted loop is found lying deep in the abdomen weighted down by its fluid contents.

Arterial mesenteric vascular occlusion is caused by emboli originating in the heart, aorta, or pulmonary veins (mural thrombi atheromatous plaques) by thrombus formation due to disease of the vessel walls secondarily to infarction of the bowel due to venous occlusion and probably due to other causes. Venous occlusion however is almost always due to thrombosis as the result of (1) slowing of the venous flow (2) diseases of the veins or perhaps (3) alterations in the clotting mechanism. Portal hypertension cavernomas of the portal system and congestive heart failure are the most common demonstrable causes. In the authors' cases arterial occlusion was more common (6 to 4) than the venous type.

Whatever the type or cause of the mesenteric blockage there are but two clinical pictures. The first is due to a sudden obstruction of a major mesenteric vessel with attendant infarction the second is one of increasing ischemia which may either subside or progress to the state of complete infarction but the

picture is identical no matter how the occlusion developed. Sudden obstruction of a major vessel in the mesentery is almost always due to advanced cardiovascular disease typically the patients already suffering from a severe ailment of the heart dramatically exhibit abdominal catastrophe manifested by acute pain nausea, vomiting and profound shock. In occlusions that develop more slowly there are three clinical stages (1) a period characterized by hyperperistalsis with colicky pain and nausea (2) an interim of intestinal paresis that produces the syndrome of partial intestinal obstruction and (3) a phase of total intestinal strangulation.

The treatment is extensive surgical extirpation of all the involved intestine numerous resections of massive amounts of bowel with a successful outcome have been reported. Theoretically anticoagulants should be of great value in prophylaxis and post operative treatment, but their use is not recommended for definitive therapy.

Features that aid in the diagnosis are (1) a history of a known predisposing cause (2) the character of the onset (3) the early disappearance of peristalsis in a case of suspected intestinal obstruction (4) the occurrence of leucocytosis in such a case without evidence of peritonitis and (5) the development of shock when all other evidence points toward partial obstruction.

WAYNE FIELD CAMERON M D

Lymphangioma of the Mesentery G V BRINDLEY and G V BRINDLEY JR. *Ann Surg* 1948 127 907

Although benign neoplasms of the mesentery are unusual and lymphangiomas are particularly rare these lesions are to be considered in the differential diagnosis of intra-abdominal tumors. Some 500 cases of chylous cysts of the mesentery were reported in the literature up to 1939.

The diagnosis is largely made only at the time of autopsy or celiotomy. Excision is the treatment of choice although resection of a portion of the adjacent bowel may be required. Marsupialization may be done when excision is not feasible.

The authors present a case report of a large lymphangioma of the mesentery of the jejunum which was successfully excised.

WAYNE FIELD CAMERON M D

An Occult Richter Hernia; Its Particular Symptomatology and Results (Ernia di Richter occultata, sua particulari anatomologia ed esito). GIULIO TOCCA. *Pol clinico sez. chir.*, 1948, 55 68.

The author's 60-year-old male patient had always been inclined toward constipation. For the past 2 years he had been getting thinner and thinner. Five years ago there was an attack of abdominal pain and vomiting which had corrected itself without special treatment. About 6 days previous to his entry into the hospital he had taken a saline laxative and with

the purgative effect experienced pain in the right lower quadrant of the abdomen. This pain persisted following the purgation despite a strict liquid diet. No further fecal emission was made and for 3 days no gas or only very little was passed and the abdomen became distended. The patient had begun to vomit. About all that the physical examination uncovered, aside from the general toxic debilitated state was the distended abdomen with a certain amount of visible peristaltic unrest. However the roentgen examination disclosed the narrowing of the intestinal lumen at the terminal end of the ileum.

At operation this narrowing was found to be the result of the intrusion of a portion of the circumference of the small bowel, about 20 cm from the ileocecal valve into a small depression leading into the internal aperture of the inguinal canal. The incarcerated portion of the bowel wall was easily removed from the inguinal indentation—it was only about 1.5 centimeters deep—and seemed intact. The small diverticular dilatation was situated opposite the mesenteric attachment. It flushed after being loosened with what appeared to be a normal blood supply, so that retention was not considered nor was any effort made to exclude the loop from the general abdominal cavity. The first postoperative day and night passed uneventfully; however the following evening the toxic picture of generalized peritonitis appeared and the patient died the following morning. Autopsy revealed from 2 to 3 cm of the terminal ileum in a necrotic condition; however there was no actual perforation. The arteries in this section of the intestinal loop were markedly dilated with a bloody suffusion involving all of the layers of the intestinal wall. Practically all of the venous channels, the local channels and those leading up into the mesentery were thrombotic.

In reporting this case the author wishes to emphasize three aspects: the probably etiological participation of the purgative in the initiation of the process of herniation; the possible influence of the loss in body weight and the increased mobility of the abdominal contents in general; and the need for extreme care in judging the viability of the incarcerated intestinal wall. JOHN W. BRECKMAN, M.D.

#### Whole Skin-Graft Repair of Inguinal Hernia C. M. MARSDEN *Brit J Surg* 9:43 35 390.

The present report deals with 63 inguinal hernias which were repaired by skin grafts, and a follow-up of 136 of the patients at 12 months. The types of hernia were classified as oblique, 70; direct, 77; and saddlebag, 7. Of these hernias, 86 were recurrent with an average duration of 6 years, and 77 were simple with an average duration of about 3 years. A postoperative febrile reaction was noted in 75 per cent of the patients. The buried skin graft is infected material, but the tissues appear to be able to overcome this, in doing so there is a general reaction with fever. There were no infections, all trivial, and 5 cases of persistent sinus. Unabsorbable suture material was used.

At 6 months there were 5 per cent and at 12 months 0.8 per cent of recurrences in the group followed. There was a high percentage of recurrences when the sac of a direct hernia was not excised. The author states that the recurrence rate, though high, is not excessive considering the type of hernia repaired. JOHN L. LINDQUIST, M.D.

#### Operative Technique for Umbilical Hernia Utilizing Skin Grafts (Técnica operatoria para hernia umbilical utilizando injerto de piel) JULIO V. URBANO and ROBERTO A. GILARZ. *Presia med. argent.* 9:43 35 717.

Umbilical hernia has a great propensity for recurrence especially in the aged and obese patient. Some authors give the recurrence rate as high as 50 per cent.

In order to obtain a solid anterior abdominal wall to prevent recurrences it has been sought to place as many layers as possible to re-enforce the weakened zone occupied by the umbilical ring. Since with the passage of time the aponeurotic planes may give way, there has been employed in front of the hernial ring, in addition to the fascial repair, a full-thickness skin graft.

The technique of repair is a modification of that proposed by Rafael Araya in 1926. General measures include preoperative bed rest, reducing diets for obese patients, medical treatment for any coexistent organic deficiencies, and in the event of very large hernias, progressive pneumoperitoneum as suggested by Gold Moreno.

For a few days prior to operation the operative site is carefully cleansed with soap and water and therapy is instituted to any local intertrigo or eczema. For the 3 days immediately preceding operation the umbilicus and the surrounding area is painted with iodine and alcohol and covered with a sterile dressing. And finally a few hours before surgical intervention penicillin is given in a dose of from 500,000 to 1,000,000 units.

When the abdominal wall is flaccid, local anesthesia is the anesthetic of choice; however, if the abdominal wall is tense a general or spinal anesthetic is preferable.

If the skin which covers the hernia is acceptable that is to say it has the characteristics of normal skin and is not debilitated or thinned or fissured or eczematous it may be employed as the graft. However if these conditions are not fulfilled and a lipectomy is anticipated, the skin graft may be obtained from one end or the other of the elliptical area excised. Or if an operation is contemplated in which the skin covering the umbilicus is to be conserved, the skin graft may be taken from another area.

If the case requires lipectomy in addition to repair of the umbilical hernia, an elliptical incision is made about the umbilicus at right angles to the long axis of the body. The extent of the lipectomy planned will govern the size of the incision. The full thickness graft is obtained from one end or the other of the ellipse. The amount of skin is removed

from the portio excised and this is placed in moist gauze or physiological saline solution. The latter procedure is preferable since any cellular or fatty tissue left in contact with the graft will imbibe liquid and be more easily removed later.

After the subcutaneous dissection of the ellipse is completed and the aponeurosis is reached the dissection is carried to the oock of the hernia. The opening of the sac, and the removal and treatment of the hernial contents differ in no way from the classical technique.

The upper and lower lips of the incision are then freed from the anterior rectus sheath. The separation of the free edges of the incision may be maintained by Gelpi self-retaining retractors.

Once the peritoneum is closed the edges of the aponeurotic onifice are approximated and sutured. If it is not possible to separate the peritoneum from the fascia, both are closed in a single plane.

Curvilinear semi-elliptical flaps are then cut in the anterior leaves of the rectus sheaths with care not to carry the incisions medially beyond the linea alba. The free edges of these flaps are then approximated medially and fixed together with interrupted sutures. Following this the muscle subjacent to the fascial layers just rearranged is freed from the posterior leaf of the rectus sheath. If the rectus muscles do not come together easily in the midline the incision in the rectus sheath may be extended vertically 1 cm. at each end. Here again great care must be exercised not to impair the integrity of the single layered aponeurotic plane medial to the linea alba.

The skin graft is then carefully inspected and any lobules of adipose or connective tissue are removed from the raw surface. The tissue is then cut approximately in the shape of an ellipse. After it is cut, the graft may seem too small. However the graft has elasticity and will stretch when sutured in place.

The graft is placed raw surface downward on the base formed by the rectus muscles, over the central portion of the hernial repair with the major axis oriented vertically. It is then sutured at either extremity with care to pull the tissue taut during fixation. The lateral portions of the graft are introduced under the anterior leaf of the rectus sheath and sutured so that tension is applied laterally. After this sutures are placed at intervals of from 5 to 7 cm. around the perimeter of the graft. Upon completion the graft should have the tension of a tambour. The free lateral edges of the rectus sheaths should then be brought together as near as possible to the midline and sutured wherever they approximate each other.

The subcutaneous tissues and skin are then brought together with care to eliminate any dead spaces. The skin is then sutured. If desired two small rubber-dam drains may be used one at either end of the incision. Neither one should be in contact with the cutaneous surface of the graft. A pressure dressing is then applied.

With a skin graft of this sort there is always danger of infection therefore as a prophylactic measure

penicillin is given for the first 48 to 72 postoperative hours.

In the event that suppuration occurs the graft endures it and is not eliminated. Actually it functions as a foreign body and maintains the suppuration thus adding to the amount of granulation tissue formed and further strengthening the anterior abdominal wall.

The patient should remain in bed for a minimum period of 2 weeks, preferably 3 and if the hernia has been very large for 4 weeks.

HAROLD W. BIRCHOFF, M.D.

## GASTROINTESTINAL TRACT

A Contribution Toward Recognizing Acute Spontaneous Dilatation of the Stomach. (Contributo alla conoscenza della dilatazione acuta spontanea dello stomaco) PAOLO COLOMBO *Arch. ital. mal. app. diger.*, 1948, 14, 98.

The author describes and comments upon a fatal case of acute gastroduodenal dilatation which came on during the sixteenth day of an illness caused by typhoid fever.

The etiology is not clear but the syndrome is made up of a compensated phase characterized by a gastroduodenal phenomenon and an uncompensated phase manifested by cardiovascular decompensation.

Reversible cases with recovery are those which do not go beyond the first phase either because of prompt therapeutic intervention or because of the spontaneous action of natural mechanisms of defense (adrenaline, prostaglandin, cortin?).

The occurrence of this condition is considered rare and was found in 0.9 cases per thousand of typhoid fever hospitalized during a 20 year period.

Diagnosis is not always as easy as it was in the author's case in which in spite of prompt and intensive treatment by aspiration with the Foucher sound and parenteral therapy the patient died within 9 hours of the onset of symptoms. The presence of fever, vomiting and signs of peritoneal irritation may lead one to believe that he is dealing with a partial or walled-off perforation. Operative intervention is fatal in these cases. Le Noir and Agasse Lafont report the death of the 8 patients operated upon or a mortality of 100 per cent.

LUCIAN J. FRODOU, M.D.

A Study of Gastric Mucosa in Various Diseases Affecting the Upper Part of the Gastrointestinal Tract. WARD CARL MEYERS *Gastroenterology* 1948, 10, 923.

The material used for this pathologic study consisted of blocks taken from the gastric mucosa in 135 cases. A routine of microscopic examination was carried out and the following organization of data was considered: the thickness of the muscularis mucosae and external muscular coat, the number and characteristics of glands, the type of cell, character of the stroma, type of muscularis mucosae and the degree of gastritis.



Thickness of the mucosa appeared to be of little comparative importance, except in the case of long-standing pernicious anemia, in which the mucous membrane especially in the fundus was thinned. Thickness of the external muscular coat was of little consequence except in the case of long-standing pernicious anemia, in which all the elements of the gastric wall undergo atrophy and destruction.

The length of the glands in cases of gastric and duodenal ulcer and in gastric carcinoma, with or without acid, differed little. Shorter glands were found in cases of pernicious anemia in which gastric resection had been performed and they were still shorter if present at all, in cases of pernicious anemia in which necropsy was carried out. Comparative counts of the number of fundic glands indicated that less destruction of epithelial elements had occurred in duodenal ulcer and that variable destruction occurred in gastric ulcer. In cases of gastric cancer with or without acid destruction was fairly uniform and slightly more severe. In all cases of pernicious anemia, severe to complete destruction of epithelial elements was noted. Tortuosity of the fundic glands, seen in severe gastritis probably represents an attempt on the part of remaining glands to compensate for the loss of destroyed epithelial elements by uneven regeneration and hyperplasia.

Except in cases of severe overwhelming atrophic gastritis, evidence of attempts at regeneration usually can be found in glandular elements. The finding of pinching off of glands by the muscularis mucosae was utilized in typing the changes in the muscularis mucosae presented herein. The formation of cysts presents evidence of severe destructive gastritis after erosion of surface epithelium with subsequent healing, leaving a blind gland buried in the mucosa.

Replacement of the cells of the gastric mucous membrane, including the chief cells by mucous goblet cells was present in all conditions except duodenal ulcer and was a minor finding in the fundus in cases of carcinoma with acid. Since replacement in the fundus was found in gastric ulcer and not in duodenal ulcer there is a possibility that the mucous membrane has greater resistance to extragastric ulcers. Also the presence of a minor degree of replacement in the fundi in cases of carcinoma with acid while the degree was major in the fundi in cases of carcinoma without acid, indicates a protective influence exercised by the presence of acid. In pernicious anemia, replacement was fairly complete. Grading of the degree of mucous replacement resulted in no conclusive findings. Paneth cells were found in 70.8 per cent of sections in which replacement was observed a slightly higher occurrence than that previously reported in the literature. On comparison it was found that the number of parietal cells was high in duodenal ulcer and diminished progressively through the other groups until in the cases of pernicious anemia in which necropsy specimens were examined no parietal cells were found.

Lymphocytic infiltration was far greater in the antrum than in the fundus in the cases of duodenal

ulcer and was definitely greater in the pylorus than in the fundus in the cases of gastric ulcer. In the carcinoma groups slightly higher grades of infiltration were found in the pylorus. No differences were observed in the groups with pernicious anemia. Edema of the submucosa is a common finding in all grades of gastritis. Hemorrhage into the submucosa was of no value in this comparative study because of the possibility that it was due to surgical manipulation. The incidence of fibrosis of the submucosa was higher in the more severe atrophic gastritis, lower in the less severe hypertrophic types. Fatty infiltration of the submucosa appeared to be definitely less in gastric ulcer and in pernicious anemia (necropsy specimens). Cellular infiltration of the submucosa was not extensive in ulcers, either gastric or duodenal, and was more extensive in cases of carcinoma and pernicious anemia in which surgical specimens were examined. Cellular infiltration in atrophic gastritis, in cases of pernicious anemia in which the necropsy specimens was examined, was definitely milder.

The state of the muscularis mucosae offers one of the most salient points in the estimation of the chronicity of gastritis. The three groups of pathologic factors presented—ulcer, cancer and pernicious anemia—showed, in the order stated, progressively increased degrees of change in the muscularis mucosae.

The grading of gastritis revealed relatively more severe gastritis at the pylorus than at the fundus in cases of duodenal ulcer, gastric ulcer and carcinoma with free hydrochloric acid. In the remaining groups gastritis was equally severe in pyloric and fundic sections.

There was very little difference in the degree of gastritis noted in carcinoma with and without free hydrochloric acid. In general, the lesions associated with the group in which free acid was still present were smaller than those in which achlorhydria was present. If the gastritis was the result of carcinoma, one might expect to find more severe gastritis in the latter group. The findings in this study are by no means conclusive but appear to be compatible with the possibility that gastritis preceded the carcinomatous lesion.

After consideration of these findings it would appear to follow that histologically the degree of gastritis lends itself well to grading on the basis of 1 to 4 by use of the previously described criteria. The status of the muscularis mucosae is an especially valuable critical unit of grading, since the degree of cellular infiltration, fibrosis, splitting and fragmentation is a fairly reliable indication of the chronicity of the inflammation.

The author hesitates to venture an opinion as to whether gastritis is a precursor to peptic ulcer or carcinoma, since the extent of this study does not warrant it. However it does appear that gastritis is the same in whatever pathologic condition of the upper portion of the gastrointestinal tract it occurs. It begins with an inflammatory reaction accompanied by hyperemia and cellular infiltration if chronicity is allowed to develop by virtue of persistence of the

etiologic factor the mucous membrane passes through successive stages of glandular destruction erosion formation of cysts destruction of the muscularis mucosa and finally a state of atrophic anadenia. All the while this is going on, the glandular elements which still persist make sporadic attempts at regeneration in an effort to regain normal function but finally fail and are replaced by an intestinal type of mucous membrane. The end result is the same, be the associated condition ulcer cancer or pernicious anemia.

**Experimental Research on the Behavior of a Loop of Intestine Isolated from Its Continuity with the Remaining Intestine and Proper Mesentery** (Ricerche sperimentali sul comportamento di un anse intestinale isolata dalla continuità col rimanente intestino e dal proprio mesenterio) RINO BALDELLI. *Gior. ital. chir.*, 1948 4 154

Adult dogs weighing from 15 to 18 kgm. were used for the author's experiments. Under aseptic precautions a loop of small intestine from 20 to 25 cm. in length was invested with omentum and placed through three avascular areas in the mesentery. The serosa was roughened in the involved area. After from 25 to 30 days a second operation was performed in which all of the blood vessels in the mesentery leading to the involved loop were ligated. The loop was then resected at its ends and the two openings were sutured to the skin and abdominal wall thereby being exteriorized. An end-to-end anastomosis was then made to re-establish the continuity of the remaining intestine.

After 9 months a third operation was performed when the isolated loop was resected and a normal segment was also resected for comparison. Following this the dog was returned to normal life.

The author after making a careful study arrived at the following conclusions:

The isolated loop with external openings maintains an open lumen which can be demonstrated by injecting either end with a liquid as it will escape from the other end. This can also be demonstrated by injecting some barium and then taking roentgenograms.

Histologic examination of the resected loop shows that it maintains itself perfectly conserving unaltered the relations and structure of its various tunics and their elements.

The adhesion of the omentum to the intestinal wall is perfect and results in the formation of vessels easily visible.

With the two openings of the isolated loop being exposed it is possible to study the physiology and pathology of this loop and also its behavior under different stimuli. (The author is now conducting research along these lines.)

It is noted that this isolated loop being attached only to the omentum and therefore freely mobile could readily be employed for plastic purposes at a distance from its source.

LEON J. FROEDT, M.D.

**Acute Intussusception in Childhood** BRENDA MORRISON and DONALD COURT. *Brit. M. J.* 1948 1 776.

A detailed study was made of 100 children who were treated for acute intussusception from 1944 to 1946 and it has been shown that the family doctor who first sees the patient has the major responsibility for the end results. In the past 30 years the mortality has fallen from nearly 40 per cent to less than 10 per cent. It is below 5 per cent for children treated in the first 24 hours but rises steeply to 20 per cent or more when the disease remains untreated for more than 2 days. Time is therefore an important and often a vital element in this disease. In the present study the authors have considered the exact duration of the illness, the time at which the different symptoms and signs made their appearance, the time the doctor was called and the time at which the child reached the hospital.

Of the 100 cases there were 83 in which accurate time intervals were known. 66 of the children were seen by a doctor within the first 24 hours but only 34 (41%) were admitted to the hospital within that period. Of the 80 children who were seen within 48 hours only 53 had reached the hospital at the end of the second day while the admission of the remainder was not completed until the seventh day. This delay is culpable in view of the increasing mortality after the second day. It suggests that the problem of acute intussusception is not primarily that of improving the method of treatment but rather the ability to suspect the disease within the first 24 hours and ensure prompt hospitalization.

A description of this disease is found in most textbooks. It has in general followed a history wherein a healthy well nourished male child at 9 months or shortly thereafter develops severe abdominal pain with pallor and collapse. The pain recurs at intervals of about one half hour and spasms persist from a few seconds to a few minutes. Vomiting may occur though it is not an important symptom. Apart from an initial stool constipation to obstipation is the rule although within a variable unspecified interval dark red blood resembling currant jelly is passed per rectum at which time the diagnosis should become apparent. The first signs are usually conclusive but the first day of illness may yield little evidence. Pallor, quietness, limpness, rapid pulse rate, restlessness, loss of skin tone and other signs of dehydration become more evident on the second and third day. Finally, the baby presents a desperate picture: anxious, gray, cyanotic, listless, restless movements of the head and limbs, coldness and blueness of the extremities and the final stage of complete peripheral circulatory failure. Fever is usually present even on the first day of the disease. The abdomen is difficult to palpate because of the resistance induced by tenderness. Once obstruction is established the distention may make it difficult to feel a mass but in a collapsed baby the tumor may be felt with the greatest of ease and little or no protest. This mass is (as has been well described in most accounts of the disease) cylindrical or

sausage-shaped and lies somewhere in the line of the colon, except in the ileocolic invaginations. Rectal examination should never be omitted. It shows (1) the presence of blood on the finger or its passage after examination (2) the direct palpation of the apex of a low intussusception, and (3) the empty even ballooned condition which is present in many cases but requires experience for recognition.

A diagnostic barium enema is scarcely ever required for the diagnosis of acute intussusception. However, enemas have their proper use in the investigation of suspected subacute or chronic intussusception.

With regard to treatment the authors state that since acute intussusception is a serious emergency and so many different medical functions are involved such as diagnosis, resuscitation, anesthesia, operative surgery and general pediatric care there will be divided authority and responsibility. It is therefore essential for treatment to be in the hands of a team, each member of which knows his part and the extent of his responsibility. It is, however, better to have a pediatrician responsible for the conduct of the case.

Preoperative treatment consists essentially of the treatment of shock and dehydration. It is risky to leave transfusion until the end of the operation when the patient may be irreversibly collapsed and the technical difficulties greatly increased by peripheral circulatory failure and the empty veins. The transfusion of blood and saline preoperatively is recommended. Satisfactory anesthesia both during and after the operation the length of the anesthesia being reduced to a minimum is important. Since these babies tend to vomit during operation a nasal catheter should be passed into the stomach preoperatively and left in position to assist first the anesthesiologist and later the pediatrician.

Because circulatory collapse can occur immediately after operation these patients require constant supervision in the operating room, on the way back to the ward, and in the ward by someone experienced in resuscitation and able to take the decisive action required. Prompt clearing of the airway, oxygen, the prevention of vomiting and aspiration by gastric suction, all may be necessary.

A review of the end results indicates that the time element and early operative interference are of major importance. SAMUEL J. FOGELSON, M.D.

Duodenitis (Duodenite). G. SOTTIN. *Arch Ital med opp diger* 1948, 4, 3.

The term duodenitis has significance anatomically and radiologically but it has little or no significance clinically.

Of the different forms of duodenitis those due to such causes as tuberculosis, lues and burns are rare and of limited interest. Other forms, of uncertain pathogenesis, are seen more frequently.

Duodenitis may be of inflammatory or noninflammatory origin. The noninflammatory type may be a glomerulotic, allergic, pseudomucous or dystrophic.

The lesions are probably initiated by dysfunction of the gastroduodenal mucosa, and are referred to as a pseudoinflammatory condition. The noninflammatory lesions present a primitive ulcer of neurovascular origin, differing from the inflammatory or erosive type of ulcer in that it penetrates the muscularis.

Duodenitis is frequently associated with gastritis, and is rarely present alone. It may also be secondary to appendicitis, catarrhal hepatitis, pancreatitis, or splenitis. Once these associated lesions initiate the duodenitis it may automatically become chronic.

The clinical forms of chronic duodenitis without ulceration are recognized as pseudoulcerative, hemorrhagic, dyspeptic, subicteric, pseudocholelithic, and pancreatic.

The diagnosis is based on the clinical and roentgenographic findings and on aspiration of the duodenal fluid. The symptoms are simple dyspepsia with duodenal pain after meals, associated with nausea. On aspiration of the duodenal contents, the amount of albumin must be determined while low value is placed on the quantity of mucus, the acid ferments and viscosity.

Therapy is the same as for chronic gastritis, mostly symptomatic and etiopathogenetic, with stress on the use of hydrated mineral. Surgical treatment must be considered as the lesion is both ulcerative and hemorrhagic.

ARTURO F. CROCELLI, M.D.

The Surgery of Duodenal Ulcer. CHARLES WELLS and A. C. BAXTER. *Br J Surg* 1948, 35, 564.

The authors report their observations, and discuss fully the indications for operation in patients with resistant duodenal ulcer. Their argument is based on a personal experience with 363 patients, all of whom were submitted to operation. A variety of operations were performed and a number of patients underwent several operations. There were 5 postoperative deaths. All operations were performed in the 10 year period from 1935 to 1945 and for reasons explained in the text, only 200 cases have been traced on recent surveys. Although this number is apparently inadequate, the authors have found such a striking contrast between the late results following different types of operations that they feel justified in drawing very definite conclusions.

Following subtotal gastrectomy the results have been satisfactory in so near to 100 per cent of the cases that it is believed the operation may be recommended with the maximum confidence and a minimum of the guarded reservation with which it has in the past been necessary to approach the subject.

Certain definite conclusions have been drawn concerning the physiology of the stomach and the steps which it is necessary to follow in order to be sure of achieving a good result.

The authors describe in some detail their own preoperative, operative and postoperative procedures. They recognize that there are alternatives and have thought it advisable to make their meaning perfectly clear even to the extent of possibly

tedious detail. In spite of the low mortality recorded it is believed that this operation is neither a very easy nor a very safe one and that it should be attempted only under the best conditions. In particular the authors recognize that they have been fortunate both as to their anesthetists and anesthetics and that these factors are important in keeping at a minimum the incidence of dangerous chest complications.

JOHN J. MALONEY, M.D.

#### Chronic Hypertrophic Stenosing (Pseudotumoral)

Tuberculosis of the Ileum (*La tuberculose hypertrophique chronique sténosante (pseudotumorale) de l'iléon*). FROELICH, FRUEHLING and KISEL. *Nicksa. J. chir.*, Par 1948, 64, 88.

In chronic intestinal tuberculosis the amount of fibrosis surpasses often by far the development of caseation and leads to obstruction of the intestine so that it may easily be mistaken for a tumor. Such obstruction is of frequent occurrence in the colon (especially in the cecum) but occurs only rarely in the small intestine.

The authors present 2 cases, one of which is of special interest: a woman of 47 years without any history of tuberculosis gradually developed vague gastrointestinal symptoms, especially pains in the epigastric region after meals. She was treated for peptic ulcer for a period of 5 years although no x-ray examination was ever done. Finally her complaints became much more severe. Diffuse colicky pains and frequent emesis occurred after the slightest intake of food and the patient became cachectic. At this time roentgenograms revealed an obstruction in one of the lower loops of the ileum. At laparotomy, 2 obstructing tumors the size of a prune were found and the involved part of the ileum was resected. Histologically the tumors proved to be large tubercles with very little caseation and marked fibrosis. The patient recovered completely after the operation and had a gain in weight of 25 pounds. This case is remarkable not only because of the rare localization of tubercles in the ileum but because no other signs of tuberculosis could be found in the patient.

WERNER M. SOLMITZ, M.D.

#### The Postoperative Serum, Sulfonamides, and Antibiotic Treatment of Appendiceal Peritonitis (Die postoperative serum-sulfonamid und antimikrobiologische Behandlung der Wurmfortsatzperitonitis).

W. RYFFEL. *J. internal chir. Brux* 1948, 8, 656.

This analytical study of over 500 cases of appendiceal peritonitis observed at Thurgauischen Kantonsspital, at Münstertingen demonstrated that the mortality rate was not significantly lowered by the use of antitoxic serum or by sulfonamide therapy. In those cases of appendiceal peritonitis in which no special postoperative treatment was administered the mortality rate was 14 per cent, in those patients receiving antitoxic coliform bacillus serum the mortality rate was 13.8 per cent while in 137 patients treated with sulfonamide therapy 12.4 per cent had a fatal outcome. A small number of

patients treated with penicillin are not included in the statistics.

Bacteriological studies showed that the coliform bacillus was the causative agent in appendiceal peritonitis, neither the bacillus enterococcus nor the bacillus perfringens were of practical etiological importance. Cultures of coliform bacilli were withdrawn from the abdominal exudate, and the sensitivity of the organisms to the sulfonamides was evaluated. In every case the sulfonamides retarded the growth of the coliform organisms but the power of inhibition varied according to the variety of the bacillus coli. In certain cases the bacteriostatic power of the sulfonamides offered some assistance in the recovery of the patient while in others the failure of such chemotherapy was confirmed by *in vitro* experiments. The injurious action of the sulfonamides on the liver must always be kept in mind.

The contradictory reports in the literature on the use of serum therapy in appendiceal peritonitis can be explained by the infinite number of varieties of the organism and of its endotoxins and the consequent impossibility of preparing a coliform bacillus serum which is sufficiently polyvalent. Any success attributed to its use is entirely fortuitous.

Contrary to general belief there is a relatively large number of coliform bacilli which are penicillin-sensitive, particularly among those found in pathological processes and which can be cultured freely *in vitro*.

ORVILLE F. GRIMES, M.D.

#### Chronic Ulcerative Colitis. WALTER LINCOLN PALMER. *Gastroenterology* 1948, 10, 767.

In 1 or 2 per cent of cases of chronic nonspecific ulcerative colitis there may be an acute fulminating course leading to death within several weeks or months. The rectum and rectosigmoid are usually initially involved and the disease may advance up the bowel in a retrograde manner. However, in the author's experience the initial extent of the disease as shown by roentgen examination is usually the maximal extent. Thus in 30 of 46 patients who were followed for a period of years, the extent of the disease did not change. In 11 patients the disease progressed and in 5 it regressed. Proctoscopic evidence of the disease was found in 97 per cent of the patients; involvement of the rectum and sigmoid was demonstrated in 58 per cent and of the entire colon in 30 per cent. The segmental form of the disease without rectal involvement was found in only 3 per cent of the cases. The extent of the disease and the severity of the symptoms are not necessarily proportional. In the diagnosis of chronic ulcerative colitis the characteristic changes in the rectal mucosa is of utmost importance. The author states that in about 2 per cent of the cases with secondary inflammatory polyposis malignant changes developed.

There are two main theories as to the etiology of this disease. Some authors believe it is caused by infection; others believe it to be of psychogenic ori-

gun. The author believes the possibility still exists that ulcerative colitis may be initiated by a specific infection and perpetuated by other organisms. Both dysenteric and amebic colitis may be transformed into the nonspecific type. The author states that he has twice seen the transition proctoscopically from amebic ulceration to the nonspecific type—a substitution of bacterial inflammation for a parasitic one. If this concept is valid many organisms may be involved: enterococci, colon bacillus, *Bacillus necrophorus*, or a virus may be implicated. There can be no doubt that emotional stress may produce hypermotility of the bowel with resulting diarrhea, and the author presents several case reports illustrating the profound influence of emotional factors in some cases of ulcerative colitis. It may be that hypermotility, no matter how induced, may lower the resistance of the mucosa to infection and bacterial invaders of undetermined type may then produce the disease.

Physical rest is of great importance in the treatment of the disease. The diet should be of low residue, relatively nonlaxative, high in calories and proteins. Supplementary vitamins may be given as needed. Parenteral amino acid and glucose feedings may be of great value in the acute phases. Antispasmodics such as belladonna and sedatives are helpful. If hemorrhoids are present operation is usually contraindicated. The author states that it is difficult to evaluate the effect of the sulfonamides and the antibiotics. In certain cases the sulfonamides or penicillin may be very successful, which would suggest the belief that different organisms may be involved.

The author has had only limited experience with streptomycin. Psychotherapy may be helpful in some cases, harmful in others. The chief indication for surgery in ulcerative colitis is intractability. Only 15 per cent of the author's cases have been referred to surgery for ileostomy with or without resection of the colon. Of the author's 141 patients, two-thirds have been able to get along quite well, 73 with medical management only and 50 after ileostomy with or without partial colectomy. Only 5 per cent of the patients have been cured, by which is meant absence of symptoms for 5 years with normal mucosa on proctoscopic and roentgenological examination. F. J. LESEKOW JR., M.D.

**Surgical Treatment of Ulcerative Colitis.** RICHARD B. CATTILL and ELMER SACKE, Jr., *J. Am. M. Ass.* 1945, 37, 979.

During the 20 year period from 1927 to 1946 inclusive, 636 patients with ulcerative colitis were seen at the Lahey Clinic, Boston. One hundred and sixty-six patients (26%) were operated upon. During this period a plan of surgical management, spearheaded by earlier surgical intervention in the course of the disease, has been evolved.

The operations are confined to three procedures: (1) ileostomy, (2) subtotal or partial colectomy and (3) total colectomy. The indications for surgery are thoroughly discussed and may be listed:

**Failure of medical management.** Patients in this group are those suffering with the acute fulminating type of disease which early tends to perforate the bowel or cause death from the toxemia of infection. In these patients, an ileostomy should be performed within a few days or a week after medical management begins to fail. In the chronic type of disease in which medical management fails, the authors indicate operation on any patient who is incapacitated for 3 or more months of each year. Also, patients with unsatisfactory nutritional states, persistent diarrhea or incontinence of the anal sphincter due to the disease can be greatly improved by operation.

**Subacute perforation, abscess, and fistula.** Free perforation of the bowel contraindicates surgery. Operation is done before perforation occurs when there are signs and symptoms of peritoneal irritation. Abscesses and fistula can be remedied only by surgery.

**Obstruction.** Contraction or stricture of the colon and rectum appears late in the course of the disease, and is a clear indication for surgery.

**Hemorrhage.** This is a rare complication of ulcerative colitis, but when it occurs operation should be advised. Patients with hemorrhage tolerate no resection, and operation is limited to ileostomy.

**Infectious arthritis.** Dramatic recovery from associated and incapacitating infectious arthritis of one or more joints results from early removal of the diseased colon.

**Polyposis.** A pseudopolypoid degeneration of the mucosa may occur and is seen frequently in patients suffering from hemorrhage. These patients also respond poorly to medical management and should have surgical resection.

**Carcinoma.** In a recent review by the same authors it was found that the average duration of disease in 15 patients in whom malignant degeneration developed, was 9 years. This represents 7 per cent of patients previously operated upon and emphasizes the need of following these patients who have had ileostomies, clinically and roentgenologically for a long postoperative period.

**Segmental colitis.** In the small percentage of cases in which ulcerative colitis is limited to a small segment of the colon or rectum a segmental resection and anastomosis may be done. However these patients must be carefully selected to demonstrate a limited process in the areas to be resected; else recurrent disease will create a greater surgical problem.

As to the type of operation, ileostomy is usually done first, thereby putting the colon at rest while the patient is observed for a period of 6 months. During this time maximum improvement should be evident on sigmoidoscopic and barium enema examinations. There are three possibilities for the patient who has had ileostomy. First, the ileostomy may be closed. In a few cases of complete remission of symptoms, for a year or more after ileostomy and negative sigmoidoscopic findings and an adequate lumen, as demonstrated by the barium enema, must all be present. Second, the ileostomy may be permanent with continued remission of symptoms. Colectomy

is not indicated in these cases. Third the ileostomy is permanent but symptoms continue and colectomy must be done for relief. About one third of these patients have a partial colectomy and about two-thirds, colectomy and abdominoperineal resection carried out in two stages.

The authors present and discuss their statistics over a 20 year period. The trend toward earlier and more frequent surgical intervention with an improved mortality rate of 4 per cent in the past 75 patients is indicated. JAMES C. MACMILLAN, M.D.

**Colectomy in Megacolon** (De la colectomie pour megacolon) JEAN QUÉNU *Mém Acad chir. Par.*, 1948, 74, 195

Only after long postoperative observation is it possible to arrive at a correct evaluation of the success of colectomy. In some patients there is gradual improvement for years after surgery whereas in others the initial excellent results are only temporary.

The author discusses his observations in 29 per cent cases in which colectomy was performed the first, 78 years, and the latest, 2 years previous to the present report. All of the patients were adults.

As to the choice of operation the author is much opposed to ileosigmoidostomy and typhlosigmoidostomy which give poor results. Colectomy of the sigmoid gives excellent results provided that the megacolon is limited to the sigmoid. If other parts of the colon besides the sigmoid are involved total colectomy is preferable to all other operative methods. The author has performed this formidable operation six times. Two of the patients succumbed to the operative shock of the 4 surviving 3 had good to excellent results.

The author admits that his experience with neurosurgery for the treatment of megacolon is limited however before deciding in favor of total colectomy he performed infiltration of the lumbar sympathetic in all cases and only when this procedure did not meet with success was total colectomy done.

WERNER M. SOLMITZ, M.D.

**Megasigmoid Clinical and Surgical Considerations** In 36 Cases (Megasigma. Consideraciones clinicas quirurgicas sobre 36 casos) ABEL N. CANÓNICO and FEDERICO R. PILHEU *Revista med. argent.* 1948 35, 434.

Canónico and Pilheu studied a series of 36 cases of megacolon involving only the sigmoid area. They found 66 per cent of the patients to be between 30 and 60 years of age and also that this condition was twice as frequent in males as in females. The most frequent symptoms found were constipation and obstruction. The frequency of complications suggested that the condition is not to be regarded as merely benign. Obstruction due to volvulus or fecal impact was present in 13 patients 4 of whom underwent emergency operations. The barium enema examination is regarded as the most precise method of diagnosing the condition of megacolon.

Medical treatment was used with advantage in patients with mild difficulty in the progression of the feces. Surgery is considered the elective treatment in advanced and in complicated cases in huge megasigmoid when there is no possibility of recuperation of the intestinal motor activity in cases with repeated episodes of mild intestinal obstruction and when the medical treatment has failed to relieve frequent fecal impactions.

The author with the aid of excellent illustrations, analyzes the results obtained both by the medical and surgical treatment. The surgical treatment used was variable: manual extraction of the fecal impaction, segmentary resection with end-to-end and lateral anastomosis, Mikulicz resection, total colectomy and sympathectomy. Of 30 patients who were operated upon only 4 died.

WILLIAM E. RICKETS, M.D.

**Which Is the Better Surgical Treatment for Cancer of the Rectum?** (Qual è il miglior trattamento chirurgico del cancro del retto?) TEODILO BIANCHI *Chirurgia*, 1948, 3, 19.

After studying 122 subjects operated on for carcinoma of the rectum, the author formulated the method of cure to be followed.

Of the 122 patients whose cases are reported, 72 per cent were men and 28 per cent were women. Eighty five per cent of the patients were between the ages of 50 and 70; the youngest patient was 23.

A radical operation was done on 86 patients with an over-all mortality of 10 per cent. Among 40 patients on whom an abdominal perineal amputation was performed the mortality was 10 per cent. Among 33 patients on whom perineal resection alone was done there was a 21 per cent mortality. Of 13 patients who were treated by abdominoperineal resection with conservation of the sphincter all survived. The greater mortality in the group upon whom perineal resection alone was performed was due to the fact that these patients were poorer risks than the others. Of 36 patients on whom a colectomy was done because the carcinoma had already metastasized the mortality rate was 27 per cent.

The author advocates a transverse colectomy in inoperable cases. When the tumor is less than 5 cm from the sphincter he prefers a perineal or an abdominoperineal amputation depending on the degree of involvement. Abdominoperineal resection with conservation of the sphincter is indicated in those cases in which the tumor is greater than 5 cm from the sphincter. Conservation of the sphincter for the betterment of the social life of the patient is stressed.

Complications such as infection of the perineal wound, fistulas and stenosis at the anastomotic site were infrequent.

ARTHUR F. CIPOLLA, M.D.

**Spasm and Fibrosis of the Sphincter Ani Due to Reflex Action** FRANCIS C. NEWTON and CHARLES A. MACGREGOR. *N. England J. M.*, 1948 339, 113.

The authors describe a clinical entity of spasm and fibrosis of the sphincter ani with marked constipation.

tion, chronic excessive use of cathartics, and vague symptoms of abdominal discomfort, anorexia, cramps, tenesmus, and flatus.

It is much more prevalent among women having occurred in 19 of 21 patients reviewed possibly because women lead a less active and more sedentary life than men and are thus more prone to constipation. The average age was 55, and all but two of the patients had taken daily cathartics for a period of years. A few patients had rectal bleeding but no rectal prolapse was encountered.

Physical examination always revealed a marked degree of spasm of the anal sphincter. Both the internal and external sphincters were found to be spastic, hypertrophied, hard, and hyperirritable. Moreover, in most cases, the internal sphincter was definitely smaller in diameter than the external sphincter.

Treatment consists of anal dilatation under a general anesthetic. Dilatation should be carried out slowly to avoid tearing of the muscle fibers with resultant hematomas and fibrosis. The time required is usually 10 minutes or until one is able to insert a total of four or five fingers to their full depth with ease. Frequently one is forced to partially incise the external sphincter in the midline posteriorly because of a shelflike hypertrophy or even fibrosis of the tissue. Hemorrhoidectomy, excision of a polyp or curettage (a fissure if indicated) should be done at this time.

In patients in whom surgery is performed the postoperative diet should consist of clear fluids with out milk for a period of 4 days, then a gradual return to a normal high-residue diet without cathartics. If no abnormality other than spasm is found, a high-residue diet without cathartics may be resumed immediately. In uncomplicated cases, rectal dilatations should begin on the fourth day and be performed daily either digitally or by the use of graduated Young's dilators. Dilatation should be continued as long as it is required to re-establish normal bowel habits and can be done by the patient himself.

ELY ELLIOTT LAZARUS, M.D.

### LIVER, GALL BLADDER, PANCREAS, AND GLEEN

Intravenous Cholecystography with Tetradolphthalic Fluorescein. GEORGE E. MOORE and MARION J. SMITH. *Surgery* 94:8, 24, 7.

The advantages of intravenous cholecystography are very real in contrast to dye administered per os. A known quantity of dye is injected directly into the blood stream, the variable factor of intestinal absorption is circumvented and the interval before the gall bladder can be visualized is shortened. For these reasons the authors believe that the report of an additional dye for intravenous cholecystography would be of interest.

Tetradolphthalic fluorescein has a low toxicity, great solubility, and contains 57 per cent of iodine. Following its administration there were no instances

of vomiting or diarrhea. All the patients were noted a light flesh-pink color by the dye and this color remained visible in the skin for several hours, but then disappeared.

The technique consists of rapid intravenous injection of approximately 40 mgm./kgm. of body weight, so that the total dose given adults ranges from 2 to 3 gm. The dye solution is adjusted so that 15 c.c. contain an individual dose. Preparation of the patient is negligible and only a light fat-free breakfast given the morning of the examination is necessary. The first roentgenogram is taken 8 hours after the injection of the dye. If this showed a gall-bladder shadow a fatty meal was administered and a second view (40 minutes later) was taken to show the contractility of the organ. If a poor or questionable shadow resulted at the time of the first picture, an additional roentgenogram was made in 3 hours. Oblique and upright views were obtained if necessary.

Subjective evaluation of the gall bladder shadows produced on the films showed densities comparable to those of tetradolphthalic.

ELY ELLIOTT LAZARUS, M.D.

Acute Cholecystitis. J. W. BARKEDALE and J. HARVEY JOHNSON. *Ann. Surg.* 94:8, 187-816.

The authors consider that the mortality of acute cholecystitis would be significantly lowered if conservatism in treatment, especially early in the course of the disease, were less in vogue. In their opinion, the education of physicians in general to regard acute cholecystitis as being as much of a surgical emergency as acute appendicitis would result in a reduction of as much as one-half the present morbidity and mortality.

Obstruction of the cystic duct is believed to play a primary role in the pathogenesis of acute disease of the gall bladder. This is usually due to stone although inflammatory edema or congenital malformation may occasionally be encountered. In 80 to 90 per cent of cases the obstruction is relieved by dislodgment of the stone into the gall bladder or by its passage into the common duct. In 10 to 20 per cent of cases, however, there is no relief of the obstruction and as the intravascular tension increases with secretion, transudation, and exudation, vascular interference progressively ensues and leads to ultimate gangrene and perforation.

Conservatism, it is argued, is fraught with danger because the clinical findings in many cases do not parallel the severity of underlying pathologic changes. The authors are in agreement with the view that there is no such thing as a "silent" or "harmless" gallstone since the future course is unpredictable. With persistent failure of visualization by the Graham-Cole test, even in the absence of positive or negative shadows, surgical extirpation is advised since 90 per cent of patients will be found to have biliary calculi.

Although the authors believe that surgery is urgent, they recommend strict individualization of cases. From 4 to 8 hours of preoperative preparation

to re-establish fluid and electrolyte balance are thought to be in order. Sedation nasogastric suction and, frequently transfusion should be used. The initial 72 to 96 hours is the optimum period for surgical intervention. From the third or fourth to the tenth day after onset is regarded as the period of advanced disease—the time of systemic depletion impaired hepatic function and local complications such as pericystic abscess and peritonitis—and surgery is indicated during this period only if the disease fails to subside or progresses. Cholecystostomy is often the procedure of choice and should be done without apology for a safe drainage is infinitely better than an heroic excision. It is believed that such advanced cases are due to neglect, procrastination and wishful waiting and could have been avoided by definitive surgery at an earlier period.

WAYNE FIELD CAMERON M D

**End Results of Unilateral Splanchnicectomy for Hypotonic Conditions of the Bile Ducts (Résultats éloignés de la splanchiectomie unilatérale dans le traitement des états d'hypotonie des voies biliaires)**  
P MAILLET GUY and M. JAUBERT DE BEAUJEU  
*Lyon chir.*, 1948 43 157

Since the first splanchnicectomy which was done for hypotonia of the biliary tract in 1941 the authors have performed this operation in a series of 112 cases. In the first group of 22 cases the operation was done for atony of the gall bladder diagnosed from cholecystographic findings without radiologic or manometric control during the operation. In most cases a test infiltration of the splanchnic nerve was used. The clinical symptoms included attacks of biliary colic constant pain in the right hypochondrium slow difficult digestion distention and constipation as well as lassitude migraine irritability and loss of appetite and weight. The results of operation were good to perfect in 22 cases fair in 1 case and poor in 2 cases. The failures emphasized the unreliability of cholecystography alone as a method of diagnosis without per-operative manometric and radiologic control.

In the second group of cases were 11 patients with atony of the gall bladder in whom the condition was diagnosed by manometric and radiologic control during operation. In the entire group of 33 cases of atony of the gall bladder the results were favorable in 21 of 23 cases which were followed up for 2 to 5 years, as well as in 6 cases followed up for less than a period of 1 year. The criteria of improvement include the disappearance or amelioration of symptoms. Since only one splanchnic nerve is resected these results cannot be due to interruption of the sensory paths. Many of these patients were able to resume their occupations although a period of adaptation is necessary to attain maximum improvement. Postoperative radiologic studies show a return of tonicity of the gall bladder. A perfect result includes absence of objective or subjective symptoms restoration of normal tonicity of the gall bladder occasionally with complete evacuation. A very satisfactory

result includes only minimal persistence of symptoms. Results were reported as very good in 80 to 90 per cent, and good in 65 to 80 per cent of patients in whom no previous treatment had been successful. In one case novocain infiltration of the splanchnic nerve had a remarkable clinical and radiologic effect. Splanchnicectomy may thus be considered the operation of choice for atony of the gall bladder in the absence of infection parietal lesions and mechanical obstruction. It is emphasized that preliminary infiltration may falsify the results of per-operative manometry.

Once the decision to operate has been made one should verify the condition of the gall bladder and pancreas perform an extemporaneous bacteriologic examination of the bile, and a manometric and radiologic examination through the vesicular puncture orifice. If the diagnosis is thus confirmed a right splanchnicectomy may be performed through a lumbar incision.

Hypotonus of the common bile duct is a frequent cause of biliary disease. The roentgenogram shows a dilated common duct, without apparent peristaltic waves emptying passively through an abnormally gaping sphincter. The degree of dilatation varies widely. If it is very marked the common duct may also be elongated with kinking and tortuosity and may suggest dolichocholedochus. The atony of the sphincter may be so marked as to prevent reflux. It is necessary to distinguish between isolated atony of the common duct and diffuse atony of the biliary tract. When a direct measure of pressure in the choledochus is possible the results are characteristic and suffice for diagnosis.

In a third group the end results of splanchnicectomy for diffuse essential atony of the biliary tract are discussed. In 5 cases followed up for 2 to 5 years the results were good in all but one of 5 cases followed up from 1 to 2 years the results were very good and in 8 of 9 cases followed up for less than 1 year results were good. There was one postoperative death due to a unique and paradoxical complication namely marked gastroduodenal distention. This was attributed to resection of the external cornu of the semilunar ganglion which has since been avoided. Failure in one case with persistence of symptoms was due to a pancreatic condition and in another case mild symptoms recurred after 3 years of perfect cure. Good results were obtained in 6 cases of atony of the common duct following cholecystectomy in 6 cases of atony of the common duct associated with calculous cholecystitis and in 3 of 4 cases of atony of the common duct associated with disease of the cystic duct.

Finally in a fifth group of cases the authors discuss the results of splanchnicectomy in chronic pancreatitis associated with atony of the biliary tract. In 2 cases the condition was associated with vesicular atony without involvement of the common duct. In 20 cases atony of the common duct was associated with important pancreatic lesions as revealed by palpation and biopsy as well as clinical observation.



which revealed induration and the vertigo of acute pancreatitis. Both conditions responded to splanchnicectomy.

From the results obtained, the authors conclude that splanchnicectomy in cases of associated biliary atony and pancreatic disturbances should never be attempted if the condition of the bile tract appears doubtful. In such cases however splanchnicectomy might yield good results following a derivation operation or an intervention restoring the permeability of the bile ducts. If the bile tract is otherwise normal, splanchnicectomy is indicated and most especially when atony of the bile ducts has been demonstrated. Manometric and radiologic control during operation is imperative. EDITH SCHANCK MOORE.

**The Accessory Pancreas Poising as a Benign Tumor of the Stomach** (Das Nebenpankreas unter dem Bilde benignen Malignanten). DIETRICH VON KAISER. *Chirurg* 918 9 54.

In the last 10 years at the University Clinic in Jena 3 cases of roentgenographically benign tumors of the stomach have been observed. In all 3 cases the condition proved to be an accessory pancreas. Investigation of the world's literature revealed 100 cases of accessory pancreatic tissue in the stomach.

The clinical history in the 3 reported cases was suggestive of a chronic ulcer of the duodenum with pyloric stenosis. Abdominal pain and vomiting were the cardinal symptoms. The radiological study however was suggestive of a benign polyp probably without a true pedicle. A rounded filling defect was present, but the mucosal folds seemed undisturbed by this defect, and the peristalsis passed over it without any deformity of the contraction. The obvious reason for this is that the tumefactions in all of the patients were either in the submucosa or in the muscularis. In one instance the tumor was cystic and contained a clear straw-colored fluid.

All 3 patients were treated by gastric resection, and all were cured. The author believes that it is impossible to confirm the diagnosis clinically and that therefore an operation must be performed.

WILLIAM C. BECK M.D.

**Blood Diastase and Lipase Changes in Acute Pancreatitis.** H. WAPENAW. *Brit M J* 915, 68.

The relative merits of two serum enzymes one for diastase and the other for lipase have been considered. The blood normally contains enzymes that are active on starch and vegetable oils. Their activity varies from person to person but is constant for each individual.

The diastase and lipase findings in 10 cases of acute pancreatitis are reported.

It was found that the two tests were equally satisfactory as indicators of acute pancreatitis. Their clinical application seems to be limited to the initial stages of the disease owing to the nature of the specific enzyme reaction. Evidence is given to show that serial diastase estimations may furnish information regarding the grade of severity of the disease.

JOHN J. MALONEY M.D.

## MISCELLANEOUS

**Eighty-Seven Abdominal War Wounds** (Sur 87 plaies abdominales de guerre). F. VAN VAREVELD. *Mém Acad. chir. Par* 915, 74. 90.

The author describes the organization and the activities of the surgical company of a medical battalion in the French Army. This unit, attached to an armored division, was organized and equipped for the development of the greatest possible mobility and for keeping as close as possible to the lines of combat. In one instance the company worked for a week at a distance of 800 meters (one-half mile) from the enemy positions in spite of terrific bombardment. The unit included a personnel of 150 individuals of both sexes, and 35 vehicles. It could be set up within 30 minutes and the equipment could be packed up and ready for march within 15 minutes. All wounded were brought to treatment in from a few minutes up to 5 hours after injury. As soon as they had recovered from the postoperative shock the patients were evacuated in heated cars provided with oxygen and transfusion equipment, most often 2 to 5 hours after surgery. The author believes that this early evacuation did not do any harm and is preferable to evacuation in the period between 12 and 48 hours after operation. During that time the danger of postoperative ileus and the lowered resistance of the intestinal sutures make evacuation and moving much more hazardous than in the beginning.

The follow-up examination of 87 patients with abdominal wounds revealed that 41 survived and 18 died; the fate of 28 was unknown. This comparatively low mortality of 30 per cent under battlefield conditions is attributed to the organization and perfect teamwork of the unit, early operation, generous transfusion of blood and plasma both preoperatively and postoperatively, the benefit of a highly skilled anesthetist, the local application of sulfanilamide powder (15 to 20 gm) and the postoperative injection of vitamin K in patients with liver injuries.

WERNER M. SOLOVITZ, M.D.

# GYNECOLOGY

## UTERUS

Rupture of the Uterus with Extrapertoneal, Mediastinal and Subcutaneous Emphysema. **Enix**  
*Resusc. Acta Obst Gyn scand., 1948 28 86*

A 39 year old obese woman was admitted to the hospital during her sixth parturition. Previous labors had been normal. On roentgen examination a large fetus in breech presentation was demonstrated. Injections of pituitrin were given because of lack of progress in labor without any particular effect. Thirty-six hours after admission repeated hematemesis was noted and suddenly 6 hours later subcutaneous emphysema of the neck and cheek associated with severe dyspnea and cyanosis occurred. A macerated fetus weighing 6 000 gm was delivered by operative breech extraction followed by manual removal of the placenta. The patient died 11 hours after delivery.

Autopsy revealed an incomplete rupture of the uterus which had caused emphysema of the left parietum. The extraperitoneal air bubbles could be followed from the broad ligament to the retroperitoneum and up to the mediastinum, neck, and cheek. The pathogenesis symptoms and treatment of emphysema are briefly discussed.

**GEORGE BLINICK, M D**

Changing Concepts in Cervical Biopsy. **KENYETT E. COX, VICTOR B. BUTLER, and WILLIAM C. SMIA**  
*Am. J. Obst. 1948, 56 172.*

A series of 7 cases of equivocal lesions of the cervix is presented. The management is described. In a total of 110 routine biopsies 2 cases of intraepithelial carcinoma were found representing an incidence of 1.8 per cent. The incidence of intraepithelial and early invasive carcinoma in this series was roughly comparable to published statistics in routine hysterectomies in which the entire cervix was immediately available for study. It was about three times the incidence reported in a series in which additional tissue was not available for study. These comparisons have led the authors to believe that if the cervix were available for study in all cases in which equivocal lesions are discovered in routine biopsy, a far greater number of intraepithelial and early invasive carcinomas would be discovered than has heretofore been possible.

As a result of their study of this small series of cases the authors' concepts of cervical biopsy have changed. In the future biopsy will be considered as a screening process in those cervixes that present no grossly recognizable cancer. Cauterization of the cervix at the time of the original biopsy will be abandoned so that additional tissue for study will be available if necessary. The finding of equivocal lesions atypical metaplasia and possible intraepithelial

carcinomas will be followed routinely by complete sectioning of the original block and wide sectioning of the cervix. Frozen sections will not be taken. Conization will be performed with the scalpel rather than the canterly so as not to desiccate the specimen.

A registry of intraepithelial carcinomas of the cervix has been sponsored by the Central Association of Obstetricians and Gynecologists. The purpose of this registry will be the confirmation of diagnosis by competent gynecologic histopathologists and provision for adequate follow-up of these cases.

It is believed that in the study of a lesion in the cervix the highest order of opinion with respect to its nature is still divided. Greater progress will be made by the concerted action of a group of gynecologists and pathologists than can be accomplished by individuals working alone.

**JOHN R. WOLFF, M D**  
**Mesonephric Remnants in the Cervix. JOHN HURTMAN. Am. J. Obst. 1948, 56 23.**

The present article concerns the embryology, histology and the microscopic pathology of mesonephric remnants in the uterine cervix. The literature has been reviewed serially-sectioned tissues have been studied and sections from 1,193 surgically excised cervixes have been examined.

The presence of an ampulla of the mesonephric duct in the fetal cervix has been demonstrated by Meyer and others. A study of serially sectioned fetal uteri confirms their observations. Remnants of these fetal elements may persist in the adult cervix either as nondegenerated structures or as neoplasms arising from such residues. These remnants will ordinarily be discovered during the study of routine sections of the cervix. The characteristic histologic appearance of mesonephric remnants in the cervix is that of small tubules or canaliculi lined by a typical low columnar nonsecretory epithelium consisting of cuboidal cells containing a translucent pale cytoplasm and large well staining ovoid or round nuclei. These tubules can be differentiated from cerplasma glands. The histopathologic appearance of neoplasms arising from these remnants is described in detail.

Five cases of mesonephric remnants in the cervix and 5 cases of neoplasms arising from mesonephric remnants in the cervix are added to the literature. There is now sufficient evidence to warrant the acceptance of mesonephric duct remnants in the cervix as a histopathologic entity.

**JOHN R. WOLFF, M D**  
**Carcinoma of the Cervix. MANUEL GARCIA and LEON J. MENTELLE. J. Am. M. Ass., 1948 137 1101**

An analysis of radical surgical treatment and radiation therapy in carcinoma of the cervix is presented. With all methods of treatment there has been a sharp rise in absolute cure rate of 5 years survival.

eously with a decided drop in mortality. The salvage in the surgical group has remained unchanged since the early part of the century while the salvage in the group treated by radiation has shown progressive improvement.

No one now uses surgical therapy exclusively. Instead the aim has been to afford each patient the maximum opportunity for recovery with minimum primary risk. In favorable cases averaging one-third of the material the patients are operated on and often irradiated too, while the rest are treated by radiation alone. This plan has been called 'elective therapy' by Stoeckel. 'Elective therapy' gives better results than those obtained during the strictly surgical era. Rigid criteria for operability, modern surgical technique and the advantages of general surgical progress have greatly reduced the mortality and complications from the operation.

Data are presented which show failure to control the disease surgically in one-third of the operative survivors as a result of recurrences within the pelvis 65 per cent appearing within 3 years.

The chance for recovery does not depend entirely on the histologic grade of the tumor. The operative mortality is higher in older women than in younger ones. The clinical and anatomic extent of the disease influences the patient's chance for recovery. Parametrial invasion is a sign of incurability.

In patients with metastasis to the pelvic lymph nodes the rate of curability after operation is decreased and the operative risk is increased.

Results are definitely improved when radiation therapy is added to surgical therapy. In addition preliminary irradiation reduces infection and the risk of peritonitis at operation.

Radiation was first used as a palliative agent in the treatment of advanced disease. In this respect it remains unrivaled and unchallenged today.

Radiotherapy carries a definite mortality risk; the principal one is exacerbation of sepsis.

Immediate morbidity is manifested in the form of radiation sickness, exhaustion or irritative phenomena in the skin, in the urinary and the intestinal tracts, and by a flare-up of latent infection. Various late sequelae may occur as injuries of variable severity such as ureteral obstruction, ulcer of the bladder, fecal fistula, intestinal bleeding and obstruction and fistulas of the bladder, rectum or intestine.

In regard to permanency of healing, no significant differences can be demonstrated in the absolute salvage obtained by radiation and by surgical treatment after a period of 10 years. The ratio of 10 to 5 year survivors averages 75 per cent in each group. Such a finding is contrary to expectation; the ratio should be significantly higher in the surgical groups for obvious reasons.

The age of the patient and grade of the tumor have no consistent relation to the possibility of cure. However serial biopsies of a tumor under treatment may constitute an important prognostic aid. Also serial vaginal smears give a good indication of the reaction to radiation in the individual tumor. All series show

that the chance for recovery is inversely correlated to the extent of the disease as determined by clinical examination. Infection is a frequent and serious handicap to treatment and it significantly impairs the results. Although complete radiation therapy is not possible in all cases, for various reasons patients completely treated have the best chance for recovery.

It is impossible to obtain conclusive information on the effectiveness of radiation in the presence of metastasis to nodes. However from the data presented it must be concluded that preliminary irradiation does produce a definite effect and that some of the metastases are destroyed.

A number of authors have emphasized the fact that patients with carcinoma in its early stages should have the benefit of hysterectomy since the incidence of recurrences after irradiation is said to be high, and in about one fourth of the cases in which hysterectomy has been done following radium therapy apparently viable cancer cells are present. The presence of such cells is not significant, since the subsequent behavior of such cells is unknown. The only valid manner of testing the efficacy of treatment is by the 5 year results. In an analysis of 1,063 cases in stage I the results obtained with radiation therapy alone and those obtained with the combined treatment do not differ significantly. On the other hand, the salvage in the surgical cases is significantly lower than that obtained with either one of the other two methods. While the routine performance of hysterectomy appears to exert no definite improvement in results, there is no doubt that many lives could be saved if hysterectomy were employed promptly in technically and clinically operable cases in which the immediate effects of radiation prove unsatisfactory.

T. FLOREY BELL, M.D.

#### MISCELLANEOUS

Stress Incontinence. MORTIMER REIDINGTON, M.D.  
J. Urol. 1948, 60: 77.

The operation of urethroplasty for stress incontinence has gained an unfavorable reputation because of the high percentage of failures, assessed by some as high as 30 per cent. The author describes an operation which in his experience has been uniformly successful in 120 cases.

The cause of stress incontinence is unknown. However two things are certain and constant (1) that there is a sagging of the neck of the bladder and that stress incontinence may be cured by lifting the neck from this sagging position, (2) that the length of the female urethra in the living is much shorter than that in the cadaver. The author has found that the length of the urethra never exceeds one inch. The bore or width of the urethra has no influence on stress incontinence. It is not necessary to have a urethrocele, nor though the condition is very often associated with a cystocele, has the presence of a cystocele any influence on the condition.

The principle of the operation is as follows: The tissues between the urethra and the pubic bones,

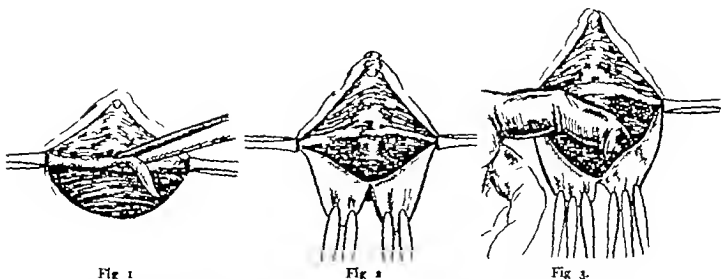


Fig 1

Fig 2

Fig 3

Fig 1 (Reddington) Removing ridge of tissue to begin urethral dissection. Fig 2 Dissection of urethra and neck of bladder. Fig 3 Freeing bladder from vaginal flaps in order to mobilize urethra and bladder neck.

acting as a finger on either side are brought under the neck of the bladder and the urethra, and in so doing displace these structures upwards under the pubic arch.

In order to do this certain conditions must be observed: (1) the whole length of the urethra, from the urethral orifice and including the neck of the bladder, must be moved into this new position; (2) the urethra and the neck of the bladder must be moved very decidedly at least one half to three quarters of an inch under the pubic arch; (3) enough firm tissue must be brought under the urethra and the neck of the bladder to ensure holding these structures permanently in the new position; (4) there must be free access to all the tissues concerned before these conditions can be fulfilled. The technique is best described in the accompanying illustrations.

The patient has difficulty in voiding the first 48 hours following operation; she is allowed up on the third day, goes home on the twenty-first day, and reports back at intervals of 1, 3, and 12 months. It is not considered wise to insert a self-retaining catheter, nearly all of these patients require to be catheterized the first 48 hours.

Among a total of over 120 operations there were 2 failures and 2 partial failures, all in early cases in which the necessity for rigid adherence to the conditions laid down was not realized. The 2 patients in whom operation failed have since been cured following a repeat operation; the 2 others who experience leakage of urine only on great strain are able to lead normal lives and consider that the small remaining disability can be disregarded.

DANIEL G. MORTON, M.D.

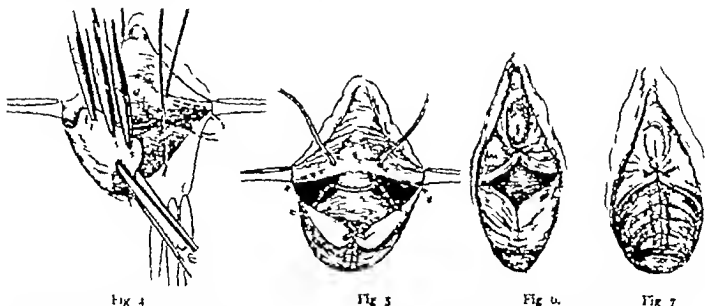


Fig 4

Fig 5

Fig 6

Fig 7

Fig 4 Removing redundant vaginal flaps. Fig 5 Uplifting suture in position and repair of vaginal edges begun. (Note for the sake of simplicity the reinforcing outlines are not shown.) Fig 6 Uplifting suture tied. Fig 7 Repair of cut edges completed.

Stress Incontinence in the Female P. A. TREARY  
and H. K. PACET *Austral. N. Zealand J. Surg.*  
1948, 17, 247

The standard operative procedure for the correction of stress incontinence in the female consists of replacing the cervix, bladder and urethra into the pelvic cavity and holding these structures in position by various means, all of which in one way or another utilize the pubocervical fascia as support. The results following this procedure are not entirely satisfactory.

In stress incontinence urine escapes with a sudden increase of intra abdominal pressure. The quantity of urine ejected is directly proportional to the amount of force and with cessation of this force there is no dribbling. In the normal woman such leakage does not occur since there is an intact pelvic floor with the bladder so buttressed that a rise in intra-abdominal pressure prevents a sudden increase in intra-venal pressure but with herniation of the bladder base and urethra through apertures of the pelvic floor (the common findings in cases of stress incontinence) the mechanics of this region are so altered that an abrupt pressure change is not dissipated over the pelvic floor but rather is concentrated in the hernia thereby forcing the sphincter with a consequent expulsion of urine. The bladder musculature plays a passive role.

The diagnosis of stress incontinence must be accurate. Cystoscopy should be done to eliminate an intrinsic bladder lesion. Then with a full bladder and the cystoscope withdrawn the meatus should be inspected for leakage or true incontinence. The patient is requested to cough and with stress incontinence a jet of urine spurts from the meatus. A finger on either side of the urethra supporting the base of the bladder will prevent loss of urine with cough. With the patient in the erect position a greater quantity of urine is ejected. Sphincter tone is ascertained by asking the patient to stop the act of micturition voluntarily.

The operation proposed is performed by the vaginal route. After an incision into the anterior vaginal wall the bladder is mobilized from the uterus and the pubocervical fascia. The entire urethra is mobilized up to the external meatus so that the seeking finger readily impinges on the pubis in front, and the ischio-pubic ramus laterally. Deep in the paraurethral fossa will be seen a white band of tissue the edge of the pubococcygeus muscle. This is stitched to the corresponding muscle of the opposite side with fine sutures of interrupted chromic catgut. The union is carried forwards until the foremost suture commences to compress the urethra and backwards until the gap of the bladder hernia has been obliterated. Prolapse is corrected if need be. The pubocervical fascia and vaginal wall are closed in the routine manner. Catheter drainage is maintained for about 10 days.

The authors cite 13 cases of patients so treated. All patients expressed satisfaction with the operative results.

WARREN R. LANG, M.D.

Genital Tuberculosis in the Female (Tuberculosis genitalis feminina. Breves consideraciones clinicas)  
MANUEL U. UTIA. *Gac. Med. Mexico* 1948, 3: 130

Of 3,578 admissions on the gynecological service of the General Hospital in Mexico, there were 18 patients with genital tuberculosis, and 50 per cent of these had a primary active or inactive pulmonary lesion. Five per cent of all cases of salpingitis were tuberculous.

The tubes were found to be involved more frequently (in from 85 to 90 per cent of patients) than any other genital organ. Involvement of the tubes occurred through hematogenous spread from a distant tuberculous focus and produced a bilateral endosalpingitis and perisalpingitis with peritoneal, pelvic, and endometrial extension. The resulting forms of salpingitis are as follows: (1) interstitial, (2) nodular, (3) hydrosalpinx, and (4) pyosalpinx.

Extension of the tuberculous process from the tube to the uterus was seen in from 35 to 50 per cent of the cases with resultant endometritis (95%) or myometritis (5%).

The ovaries were invaded in from 25 to 45 per cent of the subjects and resulted in a perioophoritis, paracystic ovarian invasion or a tubo-ovarian abscess simulating suppurative gonococcal adenitis.

Rarely (0.5%) was the cervix involved. Extension to the vagina caused two forms of infection: (1) hyperplastic granular or (2) ulcerative.

Patients with genital tuberculosis usually complain of mild pain in the iliac quadrants. Frequently they are sterile and have the following menstrual disturbances: dysmenorrhea, menorrhagia, oligomenorrhea, and amenorrhea.

On vaginal examination of the patients in the author's series, there was pain on movement of the uterus associated with a painful adnexal mass of variable size.

Laboratory examination revealed an anemia with a variable leucocytosis. The sedimentation rate was increased, and a biopsy of the endometrium showed a typical tuberculous endometritis.

The author advocates an endometrial biopsy in all patients suspected of suffering from tuberculosis of the genitalia. In those with ascites a peritoneoscopy should be done and in those having tuberculosis of the cervix or vagina guinea pig inoculation is advisable.

ARTHUR F. CROOK, M.D.

The Labhardt Operation in the Treatment of Genital Prolapse in Elderly Women (L'opération de Labhardt dans le traitement des prolapsus génitaux chez les femmes âgées) J. MARTEL. *Rev. fr. Gyn. Obst.* 1948, 43: 2

In a series of 35 cases, the author reports his experience with the Labhardt operation for genital prolapse in elderly women. This operation consists of a subtotal colectomy in which the vaginal vault is left intact, and the vagina is reduced to a narrow suburethral canal barely admitting a pencil. This is accomplished by wide excision of the lateral and posterior margins, followed by suture of the freshened

perineum. The flap is formed by five incisions the first of which is almost circular about the vaginal orifice stopping on each side about 1 cm. from the meatus. Two incisions parallel to the urethral tract are made with the bistoury. These incisions extend downward from the ends of the preceding incision for 3 to 4 cm. toward but not reaching the anterior cul-de-sac. Finally two incisions are placed down each side of the vagina terminating at about the middle of the posterior wall. In a second stage the mucosa thus circumscribed is liberated from the soft parts and resected. The author has found it simpler to liberate the flap as for repair of the posterior perineum after making a horse-shoe incision. Dissection proceeds beneath and in front of the mucosal excision which is accomplished with scissors. This technique facilitates rolling up of the suburethral mucosa to avoid its inclusion in the suture row groove. By approximating the posterior soft parts denuded of their mucosa, with several layers of transverse sutures of strong chromic catgut, a resultant perineum is constructed having a thickness of 3 to 4 cm. and a height of 6 to 7 cm. This constitutes the fourth and last stage of the operation.

Preoperative preparation of the patient includes general supportive therapy and preparation of the vaginal mucosa by small doses of folliculin or synthetic estrogen. Low spinal anesthesia in small doses is preferable. In hypertensive patients general anesthesia is preferable. Also local anesthesia is possible but it should be used only as a last resort.

Following a comparison of the basic principles of the extended Lefort operation with those of the Labhardt operation the author demonstrates from a review of the literature that the decision to use one or the other of these two interventions cannot be based on their immediate results or end results. The two operations are not competitive but each complements the other. It is therefore the anatomic condition associated with the prolapse which must determine the manner of operation to be preferred in the individual case.

In prolapse following total hysterectomy the Labhardt operation is preferable because it is technically simpler than the Lefort operation and just as efficient. Also in cases complicated by urinary incontinence the Labhardt operation is preferable. In fact,

incontinence may be exacerbated by the Lefort operation.

As a rule however the decision as to which operation is to be performed can only be made after beginning the intervention and determining the anatomic type of the prolapse.

For third degree prolapse with extensification of the cervix, either one of the operations can be used. In such cases the author still employs the extended Lefort operation. In cases of asymmetrical prolapse with marked cystocele or rectocele the Labhardt operation is believed to be better. The same is true of prolapse through an atretic vulva. Finally in cases in which the tissues are badly torn the Lefort operation is indicated.

Thus by a happy coincidence the Labhardt operation proves most useful in conditions which do not respond so well to the Lefort operation and vice versa.

EDITH SCHANCHER MOORE.

Intestinal Changes Secondary to Irradiation of Pelvic Malignancies. JEROME AL MAAS AND J. OSH 1948 55 249

Six hundred cases in which the patients received radiation therapy to the pelvic area for malignancies at the University of Wisconsin Madison, are reviewed. Transitory and permanent pathologic changes in the intestine were common. To insure adequate irradiation to a tumor of the pelvis certain irreparable changes must ensue. Radium is a more serious offender than are the x-rays. Higher doses of radiation therapy tend to produce permanent rectal lesions earlier and of a more serious nature.

In 523 patients radiation sickness developed. The onset and course of this condition are unpredictable and its management grossly unsatisfactory.

Proctitis is the most common of the permanent rectal diseases. The region of the rectosigmoid junction is the area most frequently involved. The onset and course of this condition are also unpredictable and its management is grossly unsatisfactory. The value of colostomy to check excessive bleeding or relieve obstruction is frequently negligible.

Rectal stenosis occurred in 48 cases. The process is irreversible. Rectovaginal fistula developed in 13 patients with spontaneous closure in 2.

Secondary carcinoma of the bowel occurred in 10 cases.

JOHN R. WOLFF M.D.

# OBSTETRICS

## PREGNANCY AND ITS COMPLICATIONS

Research on Glucide Metabolism in Pregnancy  
(Ricerche sul ricambio glucidico in gravidanza)  
VARGAS L. *Ginecologia* 1943, 4

The author reports the results of his studies on glucide metabolism during gestation in a series of 303 subjects. Tracings of glycemic, adrenalin and insulin curves demonstrated an intensification of the function of the insular apparatus concurrently with diminution of the metabolic activity of hepatic cells. The curves represented a total of 306 tests performed at various stages of gestation.

Two types of glycemic curves are recorded: the blood sugar level in fasting and sugar tolerance according to the method of Slinh and Traugott. Blood sugar determinations in fasting showed a slight but definite tendency to hypoglycemia toward the end of gestation.

Following the administration of glucose hyperglycemia was accentuated in the early stages of gestation, gradually diminishing in the final stages of gestation. After the injection of adrenalin hyperglycemia became less pronounced.

Following the injection of insulin hypoglycemia was shown to disappear slowly and more slowly as gestation advanced. *Amica F. Ciruela, M.D.*

Anuria in Eclampsia (Anuria en la eclampsia. Su tratamiento eficaz por la novocaina intravenosa)  
MIA DRI. D. ROSSI VESLOZZ. *Obst. g. ital-amer.* 1943, 44

Two cases of early post-eclamptic anuria are reported in which treatment consisted in the intravenous administration of 10 c.c. of 1 per cent novocain. The results were excellent and the patients had instant relief.

The author believes that eclampsia and anuria are the results of a vascular spasm in response to the internal secretions of the placenta; this transitory and paradoxical gland suddenly increased in the abnormal constellation of the permanent glands; the secretions of which the patient is unable to adapt himself.

First hypoxemia and then anoxia develop from the embarrassed circulation which later affects all the organs of the body and leads to degeneration and necrobiosis. The anuria is only the expression of renal vascular spasm at first functional and reversible but if allowed to continue it becomes irreversible and death may ensue.

Because of the premise that the condition is one of spasm, the treatment consisted of the application of a drug employed in other similar spasmodic conditions such as bronchial asthma, spasm of the retinal vessels (eclampsia amanrolica) and similar disturbances. The administration of novocain should last

about 5 minutes and may be repeated in small doses every 6 hours. *STEFANO A. ZICHMAN, M.D.*

## LABOR AND ITS COMPLICATIONS

Face Presentation. JOSEPH W. REDDOCK. *Am. J. Obst.*, 1943, 56, 86.

The results obtained in 160 cases of face presentation are reported. The frequency of face presentation in this series was 0.184 per cent. The condition occurred in multiparas three and a half times more frequently than in primiparas and mentoanterior presentations were more often seen than other positions.

Pain and its accompanying lack of abdominal and uterine tone were the most important etiological factors. Face presentation should be looked for in contracted pelvis and in patients with large babies. Breech presentations preceded complete extension of the head in 22 cases. Other factors, such as fetal neck tumors, hydramnios, placenta previa, small babies, compound presentation and the use of the hydrostatic bag in the first stage of labor probably predispose to face presentation and their presence should keep one alert for this condition. It appears that primary face presentations are not uncommon, there being 56 such presentations (among 160 patients) in which no explanation could be found for the condition.

Early diagnosis is important. Primary face presentations should be recognizable by careful abdominal palpation and vaginal examination with roentgenographic confirmation if necessary. The important findings are concave dorsal plane, prominent small parts, loud fetal heart tones heard best through the anterior fetal chest wall, and the presence of a marked cephalic prominence on the same side of the baby as is the back, vaginally, the facial features are not to be confused with the breech.

Spontaneous delivery occurred from all positions and may be anticipated, provided there is no disproportion. In most multiparas and possibly a few primiparas, the latter group cesarean section should be done electively when the diagnosis is clear after fetal death and deformities incompatible with life have been eliminated. Low forceps to the face or following flexion of the head and manual rotation may be needed to finish the delivery late in the second stage. Versions and extractions should have no place in the delivery of face presentations except in an occasional case of a second twin which presents as a face.

It should be borne in mind that the long labors and difficult operative procedures necessitated by face presentations for vaginal delivery are the chief causes of maternal hemorrhage, infection, and fetal death. The adjusted infant mortality for this series was 7.3 per cent which could be materially reduced

by more carefully watched first and second stages omission of complicated vaginal procedures when simple procedures failed and substitution of cesar can section in these cases.

JOHN R. WOLFF M D

**Symphysiotomy in the Antibiotic Era (La sinfisiotomía en la era antibiótica)** ALBERTO PERALTA RAMOS. *Obst gín lat-amer* 1948 6 3

The author believes that symphysiotomy is the operation of choice in all types of cephalic presentation, inclination of the parietal bone under favorable conditions and in cases in which the presentation is strongly bearing on the superior strait (presumably embedded or modelled) as well as to the emergency breech presentation for extraction of the aftercoming head.

Symphysiotomy is apparently used more frequently in Argentina where among 100,000 maternity cases (as of 1945) the partial symphysiotomy of Zárate was employed in 0.22 per cent of patients. The author believes that this operation has a definite advantage over other procedures for the conditions narrated and that at one time it was employed in cases of infection in place of the classical section and the low cesarean section. With the advent of the antibiotics however these latter procedures proved more advantageous and have restricted the indications for symphysiotomy.

In the proper hands symphysiotomy has shown a low maternal mortality but a fetal mortality of 2.97 per cent from 1913 to 1931. In 1945 another series of 280 cases showed the maternal mortality was zero whereas the fetal mortality was 6 per cent.

STEPHEN A. ZIEKAR M D

**A Rare Indication for Cesarean Section: Thrombotic Varicosities in the Vagina** KEIJO SORVA. *Acta obst gyna scand.*, 1948, 28 77

Varicosities of the vagina and the portio of the uterus are relatively rare and are almost always associated with pregnancy. Such varices cause serious complications during pregnancy and delivery and the mortality rate had been estimated to be 60 per cent.

The author reports the case of a 31 year old bipara who was found to have extensive vaginal varicosities 2 weeks before her expected date of delivery. Varicosities were also present in both legs and the labia. Varices were palpable throughout the vagina, except for the portio. In addition, there was a protrusion through the vulva of a tumor composed of thrombotic varices about the size of an egg attached to the posterior vagina by a thick pedicle. Because of hemorrhage, the tumor was excised with considerable difficulty. Four days later a cesarean section was performed because of continued vaginal bleeding and the danger of obstetric trauma. Postoperatively thrombosis of the right leg occurred and heparin and dicumarol were administered. She was discharged 12 days after cesarean section without symptoms.

GEORGE BLEWICK, M D

## NEWBORN

**Obstetrical Shock and Pituitary Ischemia** J F CONNORHAM. *Irish J M Sc.*, 1948, Ser 6 168

The author states that shock in an obstetrical patient is a dangerous complication which may be anticipated and frequently prevented. The cause of shock is hemorrhage, trauma or both. The hemorrhage must be severe and rapid for slow chronic bleed will not produce shock.

Trauma in the form of prolonged labor, mismanagement of the third stage of labor or extensive lacerations of the genital tract may predispose to or produce shock. Most of these conditions can be anticipated and prevented by intelligent obstetrics.

With hemorrhage there is an equal loss of all the blood constituents. The tissues may be adequately oxygenated with only 25 per cent of the red cells but there must be sufficient plasma to circulate these cells. Shock may be prevented by immediate whole blood replacement or by intravenous glucose or saline or subcutaneous saline while the blood is being prepared. Further trauma or hemorrhage must be avoided. In patients with shock, there is a loss of plasma into the tissues with a subsequent concentration of the circulating cells. The hypotension found in shock further contributes to the inadequate circulation. If hemorrhage is also present the condition is even more serious. Fluids, preferably blood or serum, must be given immediately. Sedation, heat and pressor agents are also helpful. Operation should be delayed until improvement appears.

Pituitary ischemia with subsequent necrosis may result from shock associated with parturition. If severe the necrosis may cause permanent invalidism or death. Early diagnosis may be lifesaving. The earliest symptoms are slow recovery, mental confusion and lethargy, hypotension and hypoglycemia. Anorexia results in hypoglycemia and coma, with or without convulsions. Pathological reflexes are usually present and lactation fails. The insulin sensitivity test is helpful in early diagnosis. In the later stages of this condition failure of pituitary hormone is evident.

Early treatment of pituitary necrosis consists of the prevention of hemorrhage and shock, good postpartum care and frequent observations of blood pressure, blood sugar and mental status. Hypoglycemia, if neglected for any period of time, will cause death even though the blood sugar is restored to normal levels. 300 gm or more of glucose may be necessary daily. Adrenal cortex, adequate diet, and hydrochloric acid should also be given.

J ROBERT WILLSON M D

**The Diagnosis of Postpartum Pituitary Necrosis.** D K. O'DONOVAN. *Irish J M Sc.*, 1948, Ser 6 164.

The diagnosis of postpartum pituitary necrosis during the puerperium is a difficult problem clinically and little aid is obtained from the laboratory. In suspected cases there is evidence from animal



# OBSTETRICS

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VARGO G. RABDI. *G. osteol. Tor.* 1943, 54.

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Following the administration of glucose hyperglycemia was accentuated in the early stages of gestation, gradually diminishing in the final stages of gestation. After the injection of adrenalin hyperglycemia became less pronounced as gestation advanced.

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MAYOR, B. R. *Rev. Obst. G. y Ginec.* 1943, 6: 44.

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STEPHEN A. ZIMAN, MD.

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JOHN R. WOLFF, M.D.

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GEORGE BLONICK, M.D.

**Obstetrical Shock and Pituitary Ischemia** J. CUNNINGHAM. *Irish J. M. Sc.* 1948, Ser. 6, 368

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J. ROBERT WILLSON, M.D.

**The Diagnosis of Postpartum Pituitary Necrosis.** D. K. O'DONOVAN. *Irish J. M. Sc.*, 1948, Ser. 6, 364.

The diagnosis of postpartum pituitary necrosis during the puerperium is a difficult problem clinically and little aid is obtained from the laboratory. In suspected cases there is evidence from animal

work, that a therapeutic test with the use of 200 c.c. of cortical extract with glucose and saline during the first 24 hours, may be of value. Adrenocorticotrophic hormone may also be used but it has a latent period of at least 48 hours and is not a lifesaving procedure. The diagnosis in the later stage of the disease is even more difficult but the physician should remember that any patient with chronic symptoms, especially amenorrhea which dates from the last pregnancy is a possible case of pituitary necrosis. In such cases certain tests can be done to confirm the diagnosis. The basal metabolic rate is invariably below -15 per cent. If this cannot be performed it is fairly safe to rely upon a history of increased sensitivity to cold. The fasting blood sugar is usually low but it is also well to perform an insulin tolerance test according to the method of Fraser and Smith. The characteristic response in panhypopituitarism consists of a delayed return of the lowered blood sugar following insulin to the normal or pre-injection level. A positive response (insulin hypersensitivity) is probably due to a deficiency of the G hormone of the adrenal cortex as observed in Addison's disease. The effect also may be due to a loss of a hormone or hormones secreted by the pituitary which directly affect the metabolism of carbohydrate.

The urinary 17 ketosteroids are significantly depressed below 5 mgm. per 24 hours. This gives a clue to the degree of adrenal atrophy or to the amount of N hormone secreted by the adrenals. This test is of little value in mild or borderline cases furthermore it is not specific for pituitary necrosis.

All hypopituitarism is classified as primary or secondary. The primary group includes all of the organic lesions of the pituitary the secondary group is associated with any severe cachexia such as anorexia nervosa, and the author has postulated that such patients have a reflex inhibition in their pituitary hormones in reverse order of their importance a mechanism of importance in the biological adaptation to any chronic adversity. Menstruation is usually the first to be affected by inhibition of the gonadotrophic hormone. The secretion of the important life-maintaining N hormone of the adrenal cortex is the last to be affected and is never completely inhibited in secondary hypopituitarism.

From case histories and a review of the literature, it appears that in pituitary necrosis the surviving cells in the gland behave as they do in secondary hypopituitarism that is, they produce the more essential hormones at the expense of the biologically less essential ones.

In conclusion the author states that the diagnosis of partial pituitary necrosis is based mainly on an adequate history and little assistance is obtained from the laboratory. J. ROBERT WILLSON, M.D.

Postpartum Necrosis of the Anterior Pituitary II.  
L. SHERMAN *Irish J. M. S.* 1948, Ser. 6 341

Postpartum necrosis of the anterior pituitary is a relatively rare condition only 78 cases have been reported in the literature.

Necrosis occurs about 12 hours after delivery. Histologically the process cannot be recognized any earlier although the pathological process apparently occurs around the time of delivery.

The local cause of the necrosis of the gland is a thrombosis of parts of the vascular supply with a secondary ischemia. This local result is secondary to a generalized severe circulatory collapse as a result of hemorrhage shock, or both, at the time of delivery. The obstetrical complication must be severe enough to cause hemorrhage or shock but not severe enough to kill the patient for at least 12 hours after delivery. The most common obstetrical complication is postpartum hemorrhage and retained placenta. The obstetrical complication does not cause the necrosis, but it produces the circulatory collapse and/or shock, which in turn produces the necrosis.

Puerperal patients with large pituitary necroses have the following physiological disturbances: the breasts do not become engorged with milk instead they are flaccid and devoid of secretion. The blood sugar is low usually in the range of 50 to 60 milligrams per cent. Polyuria is an inconstant finding. There is usually a loss of pubic hair.

Many patients with pituitary necrosis survive the puerperium, and the lesion becomes replaced with loose fibrous tissue. These patients, depending upon the size of the lesion are either relatively asymptomatic with only a slight delay in the return of menstruation, or they exhibit evidence of severe hypopituitarism.

At the Glasgow Royal Maternity Hospital, from 1935 to 1945, pituitary necroses were found in 25 per cent of the women who died in the puerperium later than 12 hours after delivery. Half of the necroses were large and the rest were moderate or small in size.

From these data, the author estimates that for each million of the population there were 8 large necroses in women who died in the puerperium. This evidence will probably decrease during the 1950's because of improved midwifery more adequate transfusion therapy and the use of penicillin and the sulfonamides.

The author estimates further that one in 3,500 adult women are suffering from severe chronic hypopituitarism and that their average life span after the necrosis is 15 years. He also states that along with better midwifery and the use of penicillin and the sulfonamides, more women will be saved and the total number of women suffering from chronic hypopituitarism will decrease.

J. ROBERT WILLSON, M.D.

The Neurologic Manifestations of Jaundice in the Newborn, with Particular Reference to the Chronic Residuals. LESLIE B. MAXX, JR., and CYRIL B. COURVILLE. *Bull. Los Angeles Nat. Sec.*, 1948, 23: 69.

The effects of jaundice in the newborn on the central nervous system have long excited the interest of

the neurologists. It was noted early that these effects occurred mainly in cases of icterus gravis neonatorum but the exact significance of the cause of these effects was not recognized until the discovery of the role of the Rh factor in these cases.

It is in those instances in which the infant survives (as many will with more specific treatment) and in which we find the clinical manifestations of neuronal damage that the neurologist will be concerned particularly.

As listed by Zimmerman and Yannet the structures most commonly affected in order of severity are the subthalamic nuclei, the thalamus, various nuclei of the cranial nerves, and in some instances the gray matter of the upper cervical cord.

The various theories regarding the actual cause of kernicterus are reviewed. None is satisfactory. However, the close association with erythroblastosis due to Rh incompatibility is now evident. Facts of interest concerning the disease are (1) that the nature of anti Rh antibody produced in the maternal circulation varies, i.e., it may be univalent or bivalent (2) that the Rh positive factor itself may vary as to composition (3) that cases of fetal erythroblastosis may occur which are apparently not caused by isoimmunization by the Rh factor (4) that the Rh group-specific substance is widely distributed in the tissues in varying amounts in different individuals, and yet in most cases may play little part in antigen-antibody reactions (5) that infants with erythroblastosis fetalis are particularly susceptible to asphyxia, presumably because of the reduced number of oxygen carriers (6) that a rise in titer of anti-Rh antibodies in the maternal serum may occur either early in pregnancy or not until the fetus nears term, but that the titer of anti Rh agglutinins in the blood of the mother may bear no direct relationship to the occurrence or severity of erythroblastosis in the infant (7) that in infants with kernicterus no uniformly marked anemia, icterus or other signs of blood destruction are found either clinically or at postmortem examination and (8) that icteric discoloration of the basal ganglia and gray matter has occurred without apparent premortem neurological manifestations.

It should be mentioned that cases of kernicterus have been reported which presented no evidence of erythroblastosis fetalis, icterus gravis neonatorum or even demonstrable Rh incompatibility.

The clinical manifestations of the acute phase of jaundice which may occur in the newborn with neurological symptoms are (1) the early appearance of jaundice, usually before the third day, increasing in intensity, (2) excessive somnolence and poor feeding (3) a high-pitched cry, (4) more or less intense muscular rigidity with opisthotonus, trismus, and spasms of the bulbar muscles (5) tonic and clonic convulsions, and (6) without treatment and in severe cases usually early death of the infant (during the first week).

It is in patients succumbing while icterus is present that the actual finding of nuclear staining is seen.

Of greater practical importance to the clinical neurologist are those cases of icterus gravis neonatorum in which the infant survives with evidence of chronic damage to the central nervous system. Parsons does not believe that the ultimate prognosis of icterus gravis neonatorum can ever be regarded lightly but he is however successful in its immediate treatment may be.

Sobel and Zucker have listed four late manifestations which they consider to be cardinal signs of the late syndrome of nuclear jaundice. These are (1) choreoathetosis (2) extrapyramidal spasticity (3) opisthotonus and (4) mental deficiency. They believe that the diagnosis of nuclear jaundice based purely on clinical grounds is justified if any three of these four signs are present with a history of severe jaundice at birth.

Various lesions have been reported. Two criteria must be met if one is to claim after pathological examination that a patient has survived an attack of nuclear jaundice following icterus gravis neonatorum. These criteria are as follows: (1) lesions should be limited to the striatopallidal portions of the brain which during the acute phase of the disease in the typical instance, are stained with bile pigments and show evidence of cell destruction (2) late lesions must be of a type which proves that a previous destruction of nerve elements in this system has taken place as demonstrated by (a) loss of nerve cells (b) demyelination, and (c) glial proliferation.

Studies into the possibility of Rh incompatibility as a factor in the production of feeble-mindedness have been undertaken by various groups of investigators. Klingman and Carlson reported their observations in a review of 675 cases of neuromuscular dysfunction. A history of severe jaundice was found in 45 instances. It was noted that the percentage of mental retardation and deficiency in these cases was extremely high.

Yannet and Lieberman reported the results in a group of children with IQ's below 30. These investigators found 10 cases (of 277) which might represent examples of cerebral damage due to maternal isoimmunization.

More recently Cappell has written that he does not believe that Rh incompatibility as such has any relationship to mental deficiency except as it is the etiologic factor in icterus gravis neonatorum.

Parsons and Levine have separately stated their belief that if an infant with icterus gravis neonatorum (erythroblastosis fetalis) shows any neurological signs, no attempt should be made to treat the condition. Extensive transfusion therapy in such cases might merely substitute a living idiot for a dead baby, such therapy with Rh negative blood not being able to alter nerve cell damage that might have been occurring since early embryonic development.

The treatment of patients with chronic cases is largely a matter of symptomatic care together with rehabilitation measures designed to make the best use of remaining functions.

DANIEL G. MORTON, M.D.

## MISCELLANEOUS

Why Is the Infant Born in Cephalic Presentation?  
(Warum wird das Kind aus Kopflage geboren?) W  
WOLF, *Geburtsh. und Frauenk.*, 1947 7 33.

The author discusses the different theories to explain why 97 per cent of all infants are born in cephalic presentation. The oldest is the gravity force theory which suggests that during the seventh and eighth months the head sinks toward the pelvis because of its greater specific weight. This theory was proposed first by Hippocrates and it prevailed until the beginning of this century. At that time extensive experiments with floating embryos disproved this possibility. X ray and clinical examinations show that all embryos change their position freely and frequently until the first half of the ninth lunar month. After this time their position becomes gradually more stable until in the second half of the tenth month only 27 per cent of all embryos show a change of position. Two forces have been considered as the cause of the frequent changes of position: contractions of the uterus, and active movements of the embryo. The accommodation theory supposes that the adjustment of the embryo to the anatomic shape of the uterus results in cephalic presentation. This theory has been refuted by the fact that in cases of polyhydramnios, in which no adaptation to the shape of the uterus is possible, prevalence of cephalic presentation occurs in the same proportion as in normal pregnancies.

According to the author the main cause for the genesis of cephalic presentation is the spiral arrangement of the muscle fibers in the lower uterine segment, the cervix, and in the ligaments which run from the pelvic wall to the uterus and intertwine with the fibers of the cervix musculature. The action of these fibers is similar to the strings in an old fashioned tobacco pouch or a coin purse. During the periodic

contractions of the uterus in the last period of pregnancy the lower uterine segment dilates, and the fetal head is caught by these fibers as in a trap. With each contraction the cervix descends, and the head is pulled down deeper into the small pelvis. The author devised a model to prove this mechanism. The cervix is represented by a rubber cuff. At its lower end strings are attached which represent the uterine ligaments. These strings are connected with metal rods opening the cuff in the manner of an umbrella. On pressure on a piston representing the fetal head, the cuff dilates and at the same time descends, and the piston is caught closely.

WERNER M. SCHMIDT, M.D.

Studies on Insufficiencia Pelvis (Gravidarum et Puerperarum) STÖRZ GEORGE, *Acta obs. gyn.*, second 1948, 25.

On the basis of a large clinical material a syndrome is described for which the name "pelvic insufficiency" is suggested. Pelvic insufficiency is a condition that arises during the latter half of pregnancy and manifests itself in a deficient firmness of the pelvic joints (symphysis and sacroiliac joints).

Anatomical and radiological studies show that during pregnancy a loosening takes place in the pelvic joints which brings about an increase in the breadth of these joints. The consequent instability of the pelvis gives no subjective symptoms as a rule, but in certain cases (in close to 10 per cent in the author's clinic) this causes pathological muscular reactions and symptoms. The loosening of the pelvic joints takes place through the influence of estrogen and possibly the corpus luteum hormone (relaxin) as has been clearly proved in animal experiments.

The deficient firmness of the pelvic joints, as seen in the syndrome of pelvic insufficiency, causes pathological muscular reactions in the form of contractions, especially in the erectors dorsii. Objectively there are positive Lasègue and Trendelenburg signs on one or both sides as well as disturbances in gait, in extreme cases even waddling. Direct and indirect tenderness over the pelvic joints can often be registered. Subjectively the condition involves aches, pains, and difficulties in performing various movements involving the lower limbs, pelvis, and back. Pain associated with turning in bed, walking (especially up and down stairs) and on arising from deep chairs is common. Without treatment the condition may lead to invalidism. An effective therapy consists in measures to restore to the pelvis its stability and to counteract the origin of contractions. Calcium and vitamin D medication with some form of coarct treatment works in this direction. The results of this treatment are good.

The theoretical grounds on which pelvic insufficiency can be explained in certain cases of pregnancy are discussed. It is considered probable that in the background there is either a constitutional weakness in the pelvis and its supporting and motor apparatus, or an abnormally high increment from the placenta. It is also deemed probable that estrogen has a spe-

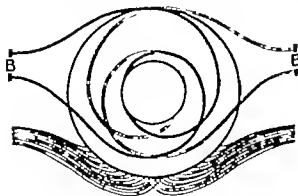


Fig. (Wolf) Arrangement of the cervix and ligament apparatus (after a drawing by Goertler). The ligament fibers are fixed to the pelvic wall at B, irradiate into the lower uterine segment, and enclose the lower uterine segment from both sides.

cific hyperemic action on the ligamentous apparatus of the pelvic joints and that future research should seek a closer explanation of the relationship between estrogen and calcium metabolism

GEORGE BLINICK, M D

Obstetrical Sequelae of Ligamentotomy by the Doléris-Pellanda Technique (Conséquences obstétricales des ligamentotomies suivant la technique de Doléris-Pellanda) J GOMEL *Rev fr gyn obst* 1948 43 27

Since some obstetricians believe that ligamentotomy for uterine retrodeviations is responsible for later obstetrical complications the author presents a study of the future fertility of women having undergone this operation based on 290 postoperative pregnancies observed during the past 6 years

As regards the effect of ligamentotomy on fertility it was demonstrated that 10.4 per cent of women who were sterile before the operation became pregnant subsequently. The pregnancies following ligamentotomy were normal in 92 per cent of primiparas and in 93 per cent of multiparas. These figures indicate that the operation has no ill effect on pregnancy. Painful pregnancies were noted in 7.5 per cent of primiparas and in 6.5 per cent of multiparas. Threatened abortion occurred in only 5 cases and bleeding during pregnancy occurred in only 2 cases. There were 36 abortions. Urinary disturbances were rare. Presentation of the fetus was normal in 96 per cent of cases. The number of breech presentations was not greater than that observed in patients who had not undergone ligamentotomy. There were 6 cases of transverse presentation attributed to faulty technique. All 6 of the patients had been operated upon elsewhere. The incidence of premature delivery in primiparas subjected to ligamentotomy was 4.5 per cent, and in multiparas 5.1 per cent. The course of labor was normal. Forceps were employed in 4.5 per cent of primiparas and in 1.5 per cent of the multiparas. It is evident that the physiologic phenomena of labor are not adversely affected by ligamentotomy. Surgical intervention was required in only 3 cases. There was no maternal mortality and aside from the infant deaths which were due to premature delivery of nonviable infants the survival and health of the infants did not seem to be affected by the operation. The delivery and the immediate and late puerperal course were normal. Extrauterine pregnancy oc-

curred in 6 patients or 2 per cent of cases. Here ligamentotomy by the older technique might have played a part. It is only fair to state that some women who were operated upon for extrauterine pregnancy and subjected to ligamentotomy later experienced normal pregnancies

Ligamentotomy on a pregnant uterus is performed only in a very early pregnancy which was not recognized or in cases of incarceration of a retroverted pregnant uterus. Only 8 such cases were observed. These 8 cases included 2 patients with normal pregnancies who had normal deliveries at term, 5 patients in whom the immediate results of pregnancy were normal and who were therefore not followed up, and 1 patient who had had an abortion 2 months after the operation.

As regards the late results of ligamentotomy some authors claim that recurrence is likely, but the majority agree that retroversion does not recur even after repeated pregnancies.

The author concludes that pregnancy is not affected by ligamentotomy if a proper technique is followed, e.g.

The uterus must be fixed just sufficiently, not too loosely or too rigidly. Also after anteversion of the uterus and verifying the state of the adnexa, it is important that a thread be passed beneath the round ligament 3 cm. to 4 cm. from its uterine insertion in order to verify by traction upon it that the peritoneum about the round ligament is quite flexible and that the tube is not involved upon traction on the round ligament. The latter should exert a symmetrical traction leaving the uterus sufficiently mobile. Fixing the round ligament too close to its point of insertion would amount to a corporeal hysterectomy, the obstetrical sequelae of which are too well known. Fixing the ligament at too great a distance from its point of insertion would favor a recurrence of the retroversion. The fixation should also be low. In this manner the round ligaments, being drawn out side of the major recti muscles, are brought into a normal anatomic position at the level of the internal inguinal orifice, pulling the uterus forward. It is likewise important to avoid the famous "death trap" which may engage a loop of the intestine. On the whole it may be said that the ligamentotomy of Doléris-Pellanda yields excellent results and has no deleterious effects on subsequent pregnancies.

EDITH SCHAMBERG MOORE

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WERNER M. SOLMITS, M.D.

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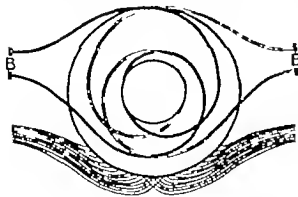


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EDITH SCHAMPE MOORE.



# GENITOURINARY SURGERY

## ADRENAL, KIDNEY AND URETER

Pheochromocytoma J A CAMPBELL COLSTON J  
*Urol. Balt.*, 1948, 59 36.

The association of the clinical syndrome of paroxysmal hypertension with tumors arising from the medullary portion of the adrenal gland—pheochromocytoma or paraganglioma—has been recorded many times in the literature.

Pheochromocytomas are usually well encapsulated though the capsule may be thin and delicate. On section the tumor is soft and has a characteristic reddish brown appearance. The tumor cells are rather large and polygonal. The cytoplasm is coarse and granular and often contains basophilic and eosinophilic granules. The pheochrome properties of the cells are evidenced by their hazy, brown color. The nuclei are usually rounded or oval and most are hyperchromatic, some with large nucleoli. In general the tumor cells more closely resemble ganglion cells than the chromaffin cells of the normal adrenal medulla.

Attacks occur in which both the systolic and diastolic blood pressures rise within a few minutes from previously normal values to astonishingly high levels. The episodes last usually for 5 to 15 minutes and are often accompanied by nausea, vomiting and fainting spells with momentary unconsciousness. During the episode there is a feeling of marked anxiety and apprehension, and following it marked lassitude and complete exhaustion. Death may occur in one of the crises, either from acute myocardial failure or from a cerebral accident. The episodes may be brought on by lying in a certain position particularly on the side in which the tumor is located by straining at stool, and by emotional crises, such as anger or sudden fear.

When a patient presents the above syndrome the probability of the presence of a pheochromocytoma should be strongly suspected. Radiographic studies should then be carried out. In the flat film and intravenous urogram, a soft tissue shadow may be visualized in the adrenal area in some cases and the corresponding kidney may be displaced downward but in many cases, particularly when a small tumor is present, no significant information can be obtained.

The author believes that perirenal air insufflation although it is of great value in many cases, often yields equivocal results and sometimes carries great danger with it.

The intravenous injection of 0.05 mgm. of histamine as described by Roth and Kvale is a valuable tentative test for pheochromocytoma. The drug induces episodes which in all respects are identical with spontaneous attacks. An abrupt rise in blood pressure is produced which dwarfs that which accompanies the cold pressor test. The great value of the

test as a diagnostic procedure outweighs any possible dangers.

As soon as a tentative diagnosis of pheochromocytoma has been made surgical removal of the tumor is indicated to prevent the further occurrence of the crises, any one of which may end fatally.

The transverse abdominal incision gives excellent exposure and allows simultaneous exploration of both adrenals, but it carries with it a greater mortality and incidence of shock than the lumbar approach. The lumbar approach on the other hand is frequently accompanied by injury to the pleura. The author makes his incision over the tenth rib, starting posteriorly at the border of the erector spinae muscles, and carries it forward and downward. The eleventh and twelfth ribs are resected to give better exposure.

Care must be taken to avoid injury to the delicate capsule of the tumor. The blood supply of the tumor usually comes from the adrenal gland itself and hemostasis is accomplished by ligation of individual vessels. The adrenal gland often lies compressed upon the tumor and this makes it necessary to sacrifice the adrenal gland in order to effect complete removal of the tumor without tearing its capsule. As much of the adrenal as possible should, however, be spared because the adrenal on the opposite side may be absent.

The author reports a unusual cases of bilateral pheochromocytomas in blood relations. In one case a pheochromocytoma recurred because of incomplete removal. This was later excised. The hypertensive crises persisted however and a large tumor was subsequently extirpated from the opposite side with complete relief of symptoms.

In the second case, the patient's maternal aunt, hypertensive crises recurred 19 months after the removal of a pheochromocytoma. A large tumor was later removed successfully from the opposite side.

FREDERICK A. LAOTO, M.D.

Management of Renal Trauma. J C KIRKBOURN  
and JOHN N. FURBER. *J. Urol.*, 1948, 59: 407.

Results of treatment in 7 cases of renal trauma are presented with detailed case reports of each patient. The patient with renal trauma may seem in excellent condition upon admission or may be in primary shock from which recovery is made in a few hours. Loss of blood may cause secondary shock a day or two later. Abdominal distention may occur but hematuria is practically always present. However the amount of bleeding does not necessarily correspond with the extent of damage. Pain is usually present. Increasing renal tenderness is caused by extravasated blood and urine and requires immediate surgery. Associated injury to abdominal viscera or the bladder may also be present. The diagnosis is based upon the history clinical symp-

toms, and physical and roentgenographic findings. The excretory urogram is especially important diagnostically. Retrograde urography should be done if the urogram is unsatisfactory. Cystoscopy and ureteral catheterization may be safely done with proper technique.

Treatment may be surgical or conservative. Surgery should be done during the interval between primary and secondary shock. The good results obtained with conservative treatment of kidney wounds during the war were misleading because the wounds were usually open and draining. Observations of early results, complications and sequelae in many cases showed that the best results were obtained by early operation. No great harm is done by an occasional unnecessary operation but delay in adequate surgery is usually followed by serious results. Conservative treatment is frequently followed by serious complications.

Early operation is indicated when there is evidence of considerable loss of blood, secondary shock, massive hematuria, or increase in size of the renal tumor in cases of thoracic or abdominal injury requiring surgery when clinical or roentgenographic evidence indicates urinary extravasation from tears of the kidney or ureter when there is wide separation of renal segments or much displacement of the kidney or ureter and when the large renal vessels are torn. Infection, hydronephrosis, calculi and other complications are indications for late operations.

The injured kidney may be removed, repaired, or drained. Serious injury to the renal vessels requires nephrectomy. A torn capsule, pelvis or ureter may be repaired preferably early. Minor tears may be cured by drainage and packing. Conservative treatment consists of necessary sedation, general care and bed rest for a week or more. It may be satisfactory in tears of the capsule, ureter or pelvis without severe bleeding. Operation is indicated however if the blood loss is severe enough to require transfusion.

Nephrectomy was done in 4 of the reported cases. 1 patient was drained and 2 patients received conservative treatment. Operation was delayed to the fifth day in 1 case because of the patient's excellent condition. The roentgenogram showed widely separated segments and extravasation. Organized blood clots made repair impossible although this might have been done the first day after injury. Another patient was not operated upon for 18 days, but nephrectomy was finally performed because of continued blood loss and symptoms of infection. Neither delay was warranted. JOHN A. LOEF, M.D.

Wilms Tumor. WILLIAM J. DAW, *J. Urol.*, Balt. 1948, 60: 18.

Daw reports 7 cases of Wilms tumor. Three of the patients survived. He does not believe that radiotherapy alone will cure Wilms tumor. He elects immediate transperitoneal nephrectomy and postoperative irradiation. Early diagnosis is imperative. Prompt removal of the tumor by either immediate

transperitoneal nephrectomy or lumbar nephrectomy preceded by preoperative radiotherapy is necessary. There is no doubt that the efficacy of any operative procedure depends chiefly upon the presence of small and undiscovered metastases. There is some degree of difference of malignancy in the various Wilms tumors; some metastasize early, others late. Upon this factor depends the chance of survival of the patients who present themselves for operation. DAVID ROSENBLUM, M.D.

Osteogenic Sarcoma of Kidney. H. G. HAMER and WILLIAM NILES WISHARD, JR., *J. Urol.*, Balt. 60: 10.

The authors report a case of osteogenic sarcoma of the kidney and in a review of the literature on tumors of the kidney they discovered only 2 similar cases. Their patient was a 76 year old male admitted to the hospital because of frequency of urination and hematuria. A roentgenographic diagnosis of stomach ulcer had been made 4 years previously. Abdominal palpation demonstrated a tumor mass in the right upper abdomen. A benign hypertrophy of the prostate, grade 2, was present. Cystoscopy demonstrated median and lateral lobe prostatic hypertrophy and bloody residual urine from the right kidney pelvis. Roentgenograms showed an egg-shaped shadow in the region of the upper pole of the right kidney, displacement of the renal pelvis laterally and some dilatation. The presumptive diagnosis was hypernephroma with calcification. Irradiation was poorly tolerated and the patient gradually weakened and died. The immediate cause of death was hemorrhage from the bowel.

At autopsy the right kidney was found to be encased in a large amount of fat. At the lower pole of the kidney and slightly lateral to it was a tumor, 10 cm. in diameter, suggestive of lipoma. The remainder of the kidney contained a large, firm tumor mass which when incised contained a very hard mass which required incision with a saw and a chisel. The tumor arose from the supportive tissue posterior to the superior pole of the kidney and had grown into the kidney pelvis and inverted it without invasion. Some parts resembled normal red bone marrow and other parts consisted of hard, eburnated bone almost stony in consistency. Sections were typical of osteogenic sarcoma of the sclerosing type. Numerous areas in the lung contained definite bone formation and osteoid tissue the same as that present in the kidney tumor. In addition a large ulcer of the stomach, 4 cm. in diameter, was present, as well as smaller ones. The source of hemorrhage evidently was the stomach as the remainder of the gastrointestinal tract was normal.

DAVID ROSENBLUM, M.D.

Ureteral Ectopia. WILLIAM J. ENGEL, *J. Urol.*, Balt. 1948, 60: 46.

Engel reports the case of a male, 21 years of age, in whom a correct clinical diagnosis of ureteral ectopia opening into the seminal vesicle was made during a study on sterility. At no time had an emission of

semen ever been observed either at coitus or with nocturnal dreams. Physical examination was negative. Intravenous urography showed prompt right kidney function and no left side visualization. Cystoscopy with a panendoscope demonstrated that the left half of the trigone was thrown into rounded cystic elevations which covered the area normally occupied by the left ureteral orifice, with encroachment upon the bladder neck. Immediately proximal to the verumontanum and to the left of the midline was an irregular dark cavernous opening, and a ureteral catheter passed into it became coiled in a large lobulated cystic dilatation of the seminal vesicle. From the vesicle emerged a dilated ureter extending up to a hypoplastic kidney lying in normal position. Engel believes that the opening in the posterior urethra permitted semen to reflux into the cavity caused by the cyst of the vesicle and dilated ureter so no ejaculation externally ever took place.

The cystic left seminal vesicle was removed and a ureteronephrectomy was performed. This interesting anomaly is due to failure of the normal shifting of the terminal portion of the wolffian ducts and the ureteric bud. When this development remains faulty the ureter may be attached to the lower end of the wolffian duct, as a result of which the ureter may open into any organ or structure derived from the terminal portion of the duct. Thus, the opening may occur abnormally in the ductus deferens, seminal vesicle, ejaculatory duct, or posterior urethra. Associated developmental anomalies are frequently observed.

D VID ROSENBLUM, M D

Retrocaval Ureter C. D CREEVEY *J Urol* Balt 94:5, 60: 26.

The author reports the case of a 12 year old girl in whom a retrocaval ureter was recognized preoperatively by the characteristic course of the ureter in the pyelogram. This is apparently the youngest patient subjected to a successful corrective operation the seventh patient in whom such an operation was successful and is the fourth case to be recognized by pyelography. The total of reported cases found by him now numbers 38.

The condition is an anomaly of the venous system in which the vena cava is formed from veins which be anterior to the ureter in the embryo and which normally disappear early in the course of development. The ureter therefore passes behind the vena cava a short distance below the renal pelvis. In many cases no symptoms have been caused, but often the ureter is squeezed between the vena cava and the underlying tissues so that hydronephrosis develops.

The author's patient was studied because of recurrent pyelonephritis. The pyelogram demonstrated, on the right side, the typical deformity: the dilated lower pelvis and upper ureter formed a hook with its convexity downward and its pointed tip overlying the lateral margin of the spine, the ureter then arched medially and downward in front of the vertebrae to the level of the sacrum after which its contour and location were normal, the dilatation ter-

minated abruptly at the lateral margin of the spine where the ureter passed under the vena cava.

A right midclitrus transperitoneal incision was made, and the ureter was exposed and followed upward to its point of disappearance beneath the medial margin of the vena cava, where it was doubly ligated and divided. The distal portion was pushed laterally between the vena cava and posterior peritoneum which then was sutured. The abdominal incision was closed, the patient was turned on her left side, and the right renal pelvis was exposed through a lumbar incision. The pelvis was freed together with the upper ligated ureter which was pulled out from behind the vena cava. The lower end was located and was approximated loosely to the upper end with a fine chromic catgut over a No. 14 Robinson catheter which was brought out through a stab in the renal pelvis. A pyelostomy was made with another Robinson catheter and both were brought out through the wound. The ureteral catheter was removed in 2 weeks, and the pyelostomy tube was removed 3 days later. The site of the anastomosis was frequently dilated for a period of 3 months after hospital dismissal, and the urine has remained clear and sterile.

DAVID ROSENBLUM, M D

Ureteropelvic Obstructions. ROR B HIRSH and CHAS. J. HAYES. *J Am. M. Ass.* 94:5, 37 777

In their explanation of the frequency of digestive disturbances in patients with renal disease, the authors emphasize the common nerve supply of the kidneys and intestinal tract. Negative findings in the urine and the absence of direct kidney symptoms do not rule out disease of the urinary tract. In ureteropelvic obstructions, malacating gastrointestinal symptoms are quite common.

With the advent of antibiotics, and recognition of the principles of treatment for partial obstruction at the ureteropelvic junction, the outlook for successful repair and conservation of renal tissue is improved. Nephrectomy should be less common.

The author summarizes his findings in 70 ureteropelvic obstructions in 51 patients who were treated during the period between 1942 and 1946. Operations were performed for 63 obstructions. Contrary to common belief extrinsic causes such as aberrant vessels, bands or adhesions are not the major factors in obstruction. In 71 per cent of cases the cause was intrinsic within the ureter with stricture and hypertrophy of the circular muscle which decreased the size of the ureteral lumen. In 3.9 per cent of cases the cause was extrinsic, and in 25.8 per cent the condition was due to combined causes.

In the preoperative study delocation of the ureteropelvic obstruction was made preferably by retrograde pyelography and a 1 minute delayed roentgenogram. In the operative procedure conformance to certain principles is more likely to insure success. The exact cause of the obstruction must be determined and it should be borne in mind that narrowing of the ureteral lumen is common and may exist even

if the ureter is normal in its outside appearance. The deformity must be adequately corrected and as a rule, the narrow ureteropelvic junction incised longitudinally. The authors have preferred the Y Foley plasty and they performed this type of repair in 45 of 63 cases. Nephrostomy drainage to divert the urine is necessary and a soft rubber catheter is inserted as a splint down the ureter about which the new widened ureter may mold. At this time pending experimental work to determine the process of ureteral healing both nephrostomy tube and catheter remain *in situ* for a period of 6 weeks.

In evaluating the success of treatment relief of symptoms alone is a false criterion. Such improvement may occur following denervation of the kidney especially around the ureteropelvic junction but progressive blockage and kidney destruction may continue. Improved renal function must be in evidence as well as improved drainage of the renal pelvis, as indicated by a retrograde pyelogram and delayed roentgenogram.

In this series, satisfactory results were obtained in 90 per cent of cases. This is a commendable figure and may be attributed to improved technique, a wise selection of cases, and a better means of controlling infection by the judicious employment of chemotherapy and antibiotics.

ALLAN K. SWERRELL, M.D.

# BLADDER, URETHRA AND PENIS

**Pedunculated Bladder Tumors.** E. GRANVILLE CRAFT. *J Urol* Balt. 1948 60 85

The author presents the remote end results in a series of 95 patients with pedunculated bladder tumors who were followed for long periods of time the majority over 7 years. The type of tumor was the pedunculated variety which remains sessile for a long time in many patients.

The treatment employed consisted of open suprapubic exposure of the bladder mucosa following which the tumor was grasped with a clamp and elevated so that other clamps could be placed below, until an apparently normal segment of tissue had been included. In some cases the entire thickness of the bladder wall was excised. Ties or sutures were used to effect the repair.

The majority of the patients treated were in the sixth and seventh decades. There was but one operative death in the entire series. Cystoscopic studies were carried out for the first 3 years and yearly thereafter.

Of 63 cases in which the author had obtained adequate data for conclusions 19 patients are well after an average period of 10.6 years. Extension of life beyond an average of 5.5 years occurred through re-exploration in 13 patients who eventually succumbed to death from tumors. Eight patients appeared to have had multiple carcinomatosis with a close relation in the appearance of the other cancers to the malignant exacerbation of the bladder tumors.

JOSEPH E. MAURER, M.D.

**Treatment of Bladder Tumors.** ARCHIE L. DEAN. *J Urol* Balt. 1948 60 92

The author states that the time has passed for advocating any single form of treatment for all bladder tumors because experience has shown that all accepted treatments have usefulness which varies in degree with different conditions in the bladder and urinary tract.

Transurethral electrocoagulation is sufficient to destroy single papillomas with bases no larger than 1.0 cm in diameter and multiple papillomas of the same size when there are no more than 15 in number.

Transurethral implantation of radon seeds with or without electrocoagulation has proved satisfactory for single papillomas or for papillary carcinomas larger than 1 cm. in diameter which are situated favorably as regards cystoscopic vision and are not too near the ureteral orifices or the vesical outlet.

Segmental resection of the bladder wall is an effective way of removing tumors of any grade of malignancy if the growth has not extended beyond the bladder wall and if the tumor can be removed with a safety zone of normal bladder wall, 1.5 cm. wide surrounding the growth. However experience has shown that segmental resection seldom removes all of the disease when the trigone is invaded by an infiltrating cancer.

Tumors between 1.5 cm. and 3 cm. in diameter either papillomas or carcinomas which are at least 1.5 cm. from the urethral orifice appear to be treated best by suprapubic cystotomy with implantation of radon seeds. If it is necessary to implant radon seeds nearer than 1.0 cm. to a ureteral orifice the ureter should be reimplanted in the bladder.

Ureterointestinal anastomosis with removal of the bladder and prostate is advocated for papillomatosis, multiple papillary carcinomas and infiltrating carcinomas which are large or which invade the trigone, prostate or ureteral orifice also for refractory recurrences after radon or segmental resection. This method of treatment is advocated occasionally when the bladder wall is extensively infiltrated and contracted. The ureters should not be dilated to a diameter greater than 1.5 cm. the bladder should be movable and there should be no more than moderate renal infection.

Cutaneous ureterostomy is followed by cystoprostatectomy for the same conditions as ureterointestinal anastomosis when the latter is technically impractical.

Röntgen therapy may cause significant temporary regression of a tumor but seldom cures and the treatment is exhausting and causes protracted cystitis and proctitis.

JOSEPH E. MAURER, M.D.

**Total Cystectomy.** EDWARD O. FERRIS and JAMES T. PRIESTLEY. *J Urol* Balt. 1948 60 98.

Total cystectomy has gradually become recognized as an important form of treatment for certain patients who have vesical carcinoma. The main problems which have impeded acceptance of this operation are (1) the selection of patients (2) the operative

technique, (3) the operative mortality rate (4) post operative preservation of renal function and avoidance of significant renal infection, and (5) ultimate results which command respect. Each of these problems is discussed. Some have been fairly well solved and others await solution. In 219 cases in which total cystectomy was planned or accomplished between the years 1937 to 1946 inclusive, the hospital mortality rate was 13 per cent. For the last 5 years of this period the rate was 8 per cent.

#### Construction of Glandular Urethra in Hypospadias.

HERBERT BRENDLER. *J. Urol.*, Balt., 94:5, 59. 64.

During the past 30 years specific efforts at curing the glandular or balanitic variety of hypospadias have largely been abandoned because of frequent disintegration of the repair as well as the development of postoperative chordee and strictures involving the glandular portion. The problem in repair of the glans has been to find sufficient tissue to assure proper relaxation of the suture lines. With this in mind the author has devised a simple method to augment the amount of skin available for this purpose by modifying somewhat the first stage of the Thiensch Duplay operation.

The operation is performed in a stages separated by an interval of at least 6 months. The first procedure encompasses (1) release of the chordee with excision of all fibrous bands, and (2) preparation of the glans for the second-stage operation. In correction of the chordee a transverse incision is most often used. Relief of the ventral curvature is based on the complete removal of fibrous tissue remnants. To aid in lengthening the penis, the hypospadiac meatus is often and proximally.

After the penis has been liberated from its ventral attachments it is dorsiflexed under moderate tension. A longitudinal midline incision is made on the ventral surface of the glans and deepened until it has attained the summit of the glans. The two halves are then spread apart bookwise and secured to the abdomen by means of mattress sutures of medium silk.

Closure is effected by conversion of the transverse incision into a longitudinal one using interrupted fine nylon sutures.

A snug gauze wrap-around is applied to the penis. The latter is maintained in dorsiflexion by a gauze bolster placed between it and the symphysis. The bolster also acts to control bleeding from the cut surfaces of the glans which is generally quite brisk. A dry occlusive dressing is applied.

Diversion of the urine by a bulbar urethrostomy or suprapubic cystostomy is performed only when indicated. Usually, however an indwelling catheter introduced through the hypospadiac meatus, suffices.

The gauze wrap-around is removed after 4 or 5 days and the silk and nylon sutures in from 12 to 14 days.

After an interval of not less than 6 months the second stage of the operation is performed. A well defined gutter is present on the ventral aspect of the glans which is completely epithelialized. The repair

is executed along the classic lines of the Thiensch-Duplay method with slight modification. The parallel incisions are extended along the borders of the urethral furrow out to the end of the glans. The edges of the tube are approximated by a running subcuticular suture of fine chromic catgut, care being exercised to roll in the epithelial margins. Closure is effected by interrupted fine nylon sutures.

The results of this method have proved most satisfactory. Of 6 patients submitted to the complete procedure, a glandular urethra has been achieved in 5. FREDERICK A. LYON, M.D.

#### Congenital Diverticulum of the Anterior Urethra (Diverticulo congenito de la uretra anterior) RICARDO ESCOBAR. *Rev. argent. urol.* 1947 6: 103.

A 16 year old boy had allegedly suffered from infancy with a peculiar condition of dysuria, being forced to adopt odd positions and contortions of the body in order to effectuate the prolonged act of micturition. The resultant stream was never full or normally powerful. A few months previously the patient had noted a small nodule located at the level of the perineum. Twenty days previously he became feverish and the dysuria was exaggerated, with intense burning, and pollakiuria every 30 or 45 minutes in turbid dribs and drops. Palpation disclosed a painful swelling the size of a large walnut, at the level of the root of the scrotum which became smaller with pressure. The excretory urogram was of no help however, the roentgen urethrogram disclosed a walnut-sized diverticulum communicating with the bulbar portion of the urethra. The youth of the patient and the long history of urinary troubles led to the probable diagnosis of a congenital diverticulum, and following regression of the gross infective condition the sac was easily dissected out and the Van Glew stain disclosed the presence of smooth muscle fibres in the otherwise densely elastic walls of the sac.

In the discussion, GONCOWITZ suggested further excretory urographic studies, despite the evidently congenital nature of the anomaly with search for disturbances of infective character in the higher reaches of the urinary tract, such as are common in affections of the neck of the bladder.

JOHN W. BRENNAN, M.D.

#### The Treatment of Stenosing and Inflammatory Pustulous Perleurethritis (Strictures with Fistula Formation) Sequelae of Acute Recurring Perleurethritis, by Urethrectomy and Extensive Perinectomy (Traitement des périurétrites aiguës à fistules inflammatoires [dits récidivants avec fistules], Séquelles de périurétrites aiguës récidivantes par urétréctomie et périnéctomie) GARCIA L. SARAQUINI. *J. urol. méd.*, Par 94: 54-3.

The author states that these lesions belong to the prehistoric surgical period. They are observed infrequently in European hospitals but are of frequent occurrence in Algeria. They are sequelae of maltreated or untreated, gonorrheal strictures, characterized by dysuria ranging from complete re-

tention to occasional urinary discomfort there is elephantiasis of the perineum from the scrotum to the anus, and the area is perforated like a sieve by multiple fistulas. The condition occurs in Moham medans between 30 and 80 years of age.

Anatomically there is involvement of the urethra and periurethral tissue. The urethra is strictured and it is impossible even after incision to introduce a probe. Still the urethra might remain patent for the passage of urine. The mucosa is irritated and proliferating and 6 to 8 cm. might be involved. The periurethral tissue is sclerotic and the sclerosus invades the spongy body and the bulbocavernosus muscles and adheres tightly to the skin.

The extent of the lesion is determined by urethrography. This is done from the external meatus only or by a combination urethrography with injection of lipiodol from the external meatus and from a catheter which has been retrogradely introduced through a cystostomy. Lipiodol (40 per cent in gomenol) is used.

Conservative treatment of these lesions is believed to be of no help. The internal urethrotomy is not indicated because it does not treat the lesion as an entity. Cystostomy for diversion of the urinary stream is beneficial only as long as the catheter is in place and when the suprapubic drainage is discontinued the condition quickly recurs.

The operation of choice is urethrectomy and wide perinectomy. The author has practiced this operation for 4 years in approximately 400 cases. The procedure is a radical one which might deter the beginner by the large defect which results. It is performed as an en bloc procedure. Routinely a guiding rubber tube (French) 18 to 24 caliber is used to unite the urethral stumps. In cases in which suture of the urethra is impossible, the regenerative power of the urethral mucosa will bridge the defect. There was no fatality among the patients in the present series. With a few exceptions, re-intervention was not necessary. During the postoperative period diathermy sounds were used.

A cystostomy was done routinely in the beginning however this is now reserved only for severe cases. If the perineum is only mildly involved and the urethrography does not reveal severe diffusion of contrast media periurethrally, no cystostomy is used. When the lesion is severe with multiple fistulas and the blood chemistry indicates kidney damage a cystostomy is indicated. The radical procedure is done after the acute inflammation has subsided and kidney function has returned to normal. Occasionally a perineal débridement is used.

Prior to operation, a catheter is introduced through the external meatus and another one retrogradely through the cystostomy. Whether or not the two catheters meet, a median incision from the scrotum to the perineal region is done. Electrocoagulation is applied for hemostasis and a square excision of the sclerotic block is attempted. The catheters must always be considered as the landmark for the longitudinal incision. If the catheters do not touch each

other this en bloc removal is done in stages all ways keeping contact with the catheters. After the healthy parts of the remaining urethra have been determined inflamed tissue must be removed towards the anus membranous urethra and scrotum. In cases in which the nrethral mucosa is heaped up it ought to be resected. The scalpel is better than the electric knife because it permits differentiation between sclerotic and healthy tissue. The guiding tube is introduced its vesical end can be guided retrogradely into the bladder by means of the original catheter or by a curved hemostat, introduced either through the cystostomy or through the perineal end of the urethra. With the guiding tube in place the urethra is sutured in several layers. Where this is impossible mobilization of the adjacent tissue will help to cover the tube. Three layers are used. Primary closure of the skin is done with a wick but without a drain. Sulfonamides are applied locally and penicillin systemically.

The postoperative care must be meticulous. The length of the guiding tube permits its exteriorization in order to clean its intraurethral part daily. Ether and gomenol oil are used for cleansing and the guiding tube is then put back into place. The wick is removed on the third or fourth day. Separation of the wound occurs only rarely. The guiding tube must not be removed in cases of complete separation. After the wound has healed the guiding tube is replaced by a Nelaton or Marion catheter and the cystostomy is allowed to close. The catheters should be changed daily and urethral diathermy is indicated every other day. Bowel movement is prevented for 6 to 7 days after operation.

In the author's cases the results were good and normal micturition occurred. Urethrograms of 4 cases accompany the article.

In the discussion Pasteau expresses some doubt as to the permanency of cure because the patients have not been seen for check ups. The author considers that a complete cure has been obtained.

ERNEST BORS, M.D.

## GENITAL ORGANS

**The Morphogenesis of Prostatic Hypertrophy and Carcinoma and Its Clinical Significance** (Die Morphogenese der Hypertrophie und des Karzinoms der Prostata und ihre Bedeutung für die Klinik)  
RUDOLF HOWARD *Helvet. chir. acta*, 1943, 15 Supp. 4

A histologic study of 300 prostate glands was carried out in order to investigate the morphogenesis and frequency of prostatic hypertrophy. The material consisted of glands obtained from specimens ranging from fetal life to senility. The author's study afforded the opportunity to observe certain features of the morphology of prostatic carcinoma and the relationship between adenomyoma and carcinoma.

The first changes of prostatic hypertrophy are observed sporadically at about the age of 45. Thereafter the degree and frequency increase proportionately with age so that in individuals over the age of

65 no prostatic gland is found free of hypertrophic changes. A distinction between the periurethral or inner gland from the prostate proper is rejected on morphologic grounds. The first evidence of growth appears in the connective tissue near the urethra where small spindle cell aggregates are found about the blood vessels. Soon the glandular alveoli in the vicinity come in contact with these aggregates so that small fibroadenomas exist which in their further development, often become pure adenomas. Inflammatory changes in the initial stages of hypertrophy are never found. Potentially all prostatic gland tissue is capable of hypertrophy yet only in the central glandular portion are adenomatous nodules found. As a result of their pressure the peripheral glandular portions atrophy. After prostatectomy the previously compromised tissue of the peripheral portion undergoes development. Large pure fibromyomas develop with particular frequency in individuals above 70 years of age.

The actual cause of prostatic hypertrophy is still not clearly understood. None of the heretofore proposed theories is entirely satisfactory. A number of morphologic and clinical observations are in opposition to the view that a disturbance in hormonal equilibrium initiates prostatic hypertrophy.

Carcinoma of the prostate occurs with greater frequency than was formerly believed. Of rare occurrence under the age of 40 it appears with increasing frequency from age 45 on so that it is found in 40 per cent of all prostate glands in the age group over 70. The author's findings are in accord with Walther's, that in 30 per cent of all prostate glands from men over 40 a carcinoma is histologically demonstrable. Carcinoma always originates outside of adenomatous areas and is independent of these. There is no evidence that prostatic hypertrophy undergoes malignant degeneration. More than two-thirds of all carcinomas have their origin from the apex of the prostate for the most part dorsal to the urethra. Carcinoma develops independently of senile atrophy primarily in a region rich in stroma and scanty in glands. It often develops immediately adjacent to the capsule or to the septum between the lobes.

In histologic structure two types can be differentiated in the early stages the first being characterized by well pronounced alveoli which stand out much more prominently than normal gland tubules, while the second is characterized by narrow alveoli and solid strands of cells embedded in a rich stroma suggestive of a scirrhous tendency. Other cases develop as carcinoma simplex, and often different growth types appear in the same preparation. Carcinoma lying adjacent to the capsule has a pronounced tendency to break through the capsule into surrounding structures. Localized atypical epithelium in the prostate gland was formerly described, but at present an uninterrupted series of changes are recognized between the so-called atypical epithelium and infiltrating carcinoma so that all such changes must be considered as beginning carcinoma.

Since prostatectomy does not eradicate that region of the gland from which carcinoma most frequently originates it does not provide a better guarantee against the possibility of later development of carcinoma than partial electroresection. From this viewpoint there is scarcely any difference between different methods of prostatectomy. Only when carcinoma is recognized early can it be eradicated surgically with expectation of lasting cure. Therefore it is important to perform rectal examination on all men over 50. Prostatectomy for carcinoma must be carried out by the perineal or sacral route so that the posterior portion of the capsule can be removed. In the majority of cases which do not permit a safe radical operation a palliative electroresection offers as much as the more dangerous radical operation. The histologic examination of prostatic tissue obtained by electroresection or biopsy which reveals only adenomatous tissue, does not eliminate the possibility of carcinoma in the neighboring gland.

JOHN L. LUNDQUIST, M.D.

Causes of Death Following Transurethral Resection. WILLIAM L. McLAUGHLIN, JOHN P. BOWLER, and JOHN D. HOLTCRIST. *J Urol* Balt., 1943, 51, 33.

In a review of 561 cases of transurethral prostate resection performed at the Mary Hitchcock Memorial Hospital from 1933 until May 31, 1943 it was found that 16 patients had died, a mortality rate of 2.9 per cent. The authors discussed the cause of death in these 16 cases, 13 of which came to autopsy.

51 deaths were due to septicemia, 4 to carcinoma, 4 to anuric complications and 3 to oliguria syndrome. Death was due to hemorrhage and shock in 1 case, to agranulocytosis in 1 case and to necrosis of the adrenal gland in 1 case.

Each one of the patients having oliguria syndrome had excessive bleeding with prolonged attempts at hemostasis. Two of these patients had perforation of the vesicle neck, and 1 had the typical renal findings associated with lower nephron nephrosis.

The exact mechanism of the oliguria syndrome, although not entirely understood is considered by the authors to be due to tissue damage associated with hemolysis of red blood cells or destruction of peritubular and perivascular tissues. These conditions lead to a specific renal response characterized by lowered urinary output and uremia.

The tissue damage is probably brought about by hypotonic irrigating solution (sterile tap water) which hemolyzes the blood as it enters the circulation by way of the prostatic veins or by injury to the peritubular tissues when perforation occurs.

The oliguria syndrome can be prevented by the use of isotonic solutions. Irrigating media such as physiologic saline or 5 per cent dextrose solutions have definite limitations. In order to prevent excessive hemoglobinemia, the authors advise reduction of the height of the irrigating solution to the lowest possible effective level and avoidance of prolonged attempts at hemostasis when bleeding is excessive.

The authors include a brief clinical and pathological résumé of the cases of the 16 patients who died.

To summarize the authors suggested that the technique of transurethral prostatic resection should be better understood and applied in order to reduce the mortality of this operation further.

The use of prophylactic antibiotics and chemotherapy before and after transurethral resection should materially reduce the incidence of death due to sepsis.

Fatal pulmonary accidents due to thrombosis of the leg veins could be reduced by early mobilization and the use of active leg exercises.

The use of isotonic irrigating solution or the judicious use of sterile water during transurethral prostatic resection should reduce the incidence of the oliguria syndrome.

CONRAD A. KUTZKY, M.D.

**The Distribution of the Testicular Artery (Internal Spermatic Artery) to the Human Testis.** R. G. HARRISON and A. E. BARCLAY. *Brit J Urol* 1948 20: 57.

A detailed study of the vascular supply to the human testis is demonstrated by roentgenography and microarteriography after the injection of radiopaque media into cord vessels. The authors arrive at certain basic generalities regarding the vascular pattern of the testicular artery which are correlated with the mechanism of heat exchange in the testis and afford speculation on technical principles suitable for the preservation of arterial supply in orchopexy.

The many discrepancies noted in the observations made by anatomists in the past beginning with the earliest description by Regnerus de Graaf in 1677 prompted this investigation. Fifteen fresh postmortem specimens of human testes from 9 individuals varying in age from 10 to 65 years were used. After a preliminary saline irrigation of the vascular system the specimens were injected either in a cord artery or vein as required with a radiopaque material. In most instances a 5 per cent colloidal bismuth solution with a few drops of wetting agent were used. Plain and stereoscopic lateral and anteroposterior roentgenograms of the gross specimens were taken. To visualize the finer details by microarteriography 3 mm. transverse sections were used.

The study showed generally that the testicular artery in its course down the cord first gives off branches to the cord itself then at an inconstant distance from the testis a variable number of arteries to the caput epididymis and the cauda epididymis. Descending further the artery may remain undivided or it may divide into as many as four branches at a variable distance from the ultimate destination at different points on the posterior border of the testis medial to the epididymis. Contrary to textbook teaching no main arterial branches pass in through the mediastinum. The artery single or divided passes obliquely through the thickness of the tunica albuginea to the underlying tunica vasculosa. Once in this area the vessels ramify over the surface of the testis in a variable pattern. The terminal branch

es converge in a centripetal manner along the septa toward the mediastinum, usually giving off secondary branches en route. The vessel may break up in to small twigs before reaching the mediastinum, or may bend back and form centrifugal vessels. Recurrent arteries are more numerous than those which pass straight to the mediastinum.

In the epididymis the caput is most favorably supplied with its branch or branches taking origin from the main stem as far as  $3\frac{1}{2}$  inches from the upper testis. The arterial supply to the cauda may arise from divisions of the testicular artery or from the artery to the caput. The body of the epididymis receives the least direct contribution from the testicular artery.

In contrast to the arterial supply only a very small part of the venous drainage takes place through superficial vessels in the tunica albuginea. There are two groups of main venous tributaries in the substance of the testis. One group previously unobserved runs through approximately the middle of the testis connects with a vorticoso arrangement of small veins on the free surface of the testis, and acts as a short-circuiting anastomosis. The other deep veins converge toward the posterior border of the testis and drain only the parenchyma. All ultimately converge essentially to the region of the mediastinum to form a complex network of tortuous vessels which form the pampiniform plexus.

A suggestion is made that the details of the vascular pattern of the testis may be related to a mechanism for exchange of heat. The testicular artery lying in the midst of the profusely anastomosing pampiniform plexus may give up heat to these venous components. The arteries too run an extensive course on the surface of the testis before supplying the parenchyma and again heat may be given off. An issue of practical importance emerges from the superficial ramifications of the artery on the surface.

It is most desirable in performing orchopexy to preserve the testicular blood vessels particularly for spermatogenesis. Yet, in the Torek operation the tunica albuginea is stitched to the fascia lata. If the testicular artery is undivided and lies on or close to the lateral surface of the testis, it is possible that such stitches may inadvertently ligate the only blood supply to the parenchyma through the vessel before the terminal branches which course inwards along the septa are given off. Such danger exists also in the operation for testicular fixation in torsion of the cord in which mattress sutures fix the tunica albuginea to the wall of the scrotum on the one hand and to the septum testis on the other.

ALLAN K. SWERDZ, M.D.

## MISCELLANEOUS

**Dissolution of Urinary Calculi.** EDWARD D. KEYSER, PHILIP C. SCHERER and LAWRENCE W. CLAFFEY. *J Urol* Balt., 1948 59: 826.

Practically all efforts to dissolve urinary calculi have been based upon the use of chemicals against



the crystalline part of the stone. The organic framework uniting the crystals has been ignored. In vitro studies were therefore made in attempts to develop an attack upon this organic framework. Urine is a supersaturated solution of numerous substances practically insoluble in water. Certain hydrotrophic compounds in urine make these substances soluble. One of these is urease, a hyperactive enzyme. These studies indicated that urease aids in dissolving calculi by permitting destruction of both their inorganic constituents and organic matrix. Papaya and trypsin were found less effective.

Attempts to dissolve calculi were made with ferments and G citrate solution administered by irrigation through ureteral catheters or nephrostomy tubes. The clinical application is described. The ferments used were 0.5 per cent urease, 0.5 per cent orthoxyme 10, and from 0.25 to 0.5 per cent ficin proteinase. These solutions were unsterilized. Case selection is important when attempting to dissolve calculi. Previously passed stones may be analyzed but attempts must otherwise be made to determine the nature of the calculus by the roentgenographic, urinary and blood findings. Oxalic and uratic calculi resist dissolution. The method of dissolution is not yet applicable to stones better removed surgically to those associated with a single kidney or to those associated with a hypofunctioning kidney on the opposite side. It is most useful for dissolving fragments left after operation or early calcareous recurrences. The patient must be intelligent, able to tolerate indwelling catheters and psychologically capable of staying in

bed and working with the apparatus for from 7 to 10 days. Sulfonamides or penicillin are used while the irrigation is in progress. The effort is stopped if roentgenograms do not show a definitely smaller stone after 10 to 14 days.

In these studies 0.5 per cent urease was the most effective stone solvent. Orthoxyme, ficin proteinase and trypsin were comparable but less active. They act as digestants, partly dissolving the colloidal or organic matrix of the calculus and causing it to become so swollen that the crystalline matter is loosened and made more susceptible to dissolution by crystalline solvents. The action of G solution in vitro especially on alkaline calculi was intensified and accelerated by these enzymes. Irrigations with ferment-G solutions have been used in 18 cases of urinary calculi and alkaline-encrusted cystitis. Excellent results were obtained in cleaning up incrustations about suprapubic and nephrostomy tubes but several failures occurred with renal calculi. A stag-horn calculus in an infected kidney was materially diminished in size by using a nephrostomy above and a ureteral catheter below but nephrectomy was necessary because of increasing infection. The method was ineffective in a case of Proteus infection.

More clinical experience is required for proper evaluation of this procedure. The ideal stone solvent has not yet been discovered but is expected to be some diet, drug, or hormone which will be given orally or parenterally and which will secrete some stone solvent from the kidney.

JOSEF A. LUTER, M.D.

# SURGERY OF THE BONES, JOINTS, MUSCLES, TENDONS

## CONDITIONS OF THE BONES, JOINTS, MUSCLES, TENDONS, ETC.

**Bone and Joint Changes in Hemophilia with Report of Cases of So-Called Hemophilic Pseudotumor** RALPH E. GROOMLEY and REED S. CLEGG.  
*J Bone Surg* 1948, 30-A 589

The authors report 6 cases of bone and joint changes in hemophilia and, on the basis of these cases thought it reasonable to conclude that in persons affected with this condition so-called hemophilic pseudotumors may arise first from hemorrhages originating in the joint and extending along the bone to produce pressure erosion second from subperiosteal hemorrhages which may at first lead to formation of new bone and later to the absorption and destruction of bone and third from cortical or medullary hemorrhage which may lead to cystic changes and later may destroy the bone or lead to fracture and further hemorrhage.

They considered it difficult in any one case to state accurately which route was followed. On the other hand it seems important to be able to recognize the condition early enough so that the destructive changes may be kept under control.

**Osteoperiostitis Simulating Tumor. Some Remarks about Radiodiagnosis.** Les ostéopériostites d'aspect tumoral. Quelques remarques sur le radiodiagnostic. F. BACLET, P. MALGRAS and G. GRICOUR.  
*Off J chir.*, Par 1948 64 249

The differential diagnosis between subacute or chronic osteoperiostitis and tumor of bone often presents a difficult problem to the clinician. The authors discuss 3 cases of osteoperiostitis in which the diagnosis was correctly made by roentgenography before biopsy was done. The condition cleared up under treatment with penicillin in all 3 patients.

The differentiation between inflammation and tumor are discussed and demonstrated in an instructive series of roentgenograms. Osteosarcoma usually involves the metaphysis only and stops at the epiphyseal line whereas in osteoperiostitis the lesions tend to spread toward the epiphysis and reach the articular surface. WERNER M. SOLOVITZ, M.D.

**Two Cases of Melorheostosis (Deux cas de méloréostose)** E. SORREL and L. QUÉNU. *Rev orthop* Par 1948 34 3.

Melorheostosis was described first by Léri, in 1929 as a not congenital hyperostosis involving the entire or almost entire length of the bones of one extremity either superior or inferior. The disturbance is very rare, only 40 cases having been published in the literature. In most cases the first symptoms were swelling of one finger or toe and limitation of movement in the adjacent joints. Very gradually in the course of years the hyperostosis spreads along all the bones

of the involved limb. In about half the cases on record signs of scleroderma were marked in the area of the hyperostosis.

The authors discuss 2 cases of melorheostosis beginning in early childhood and developing over a

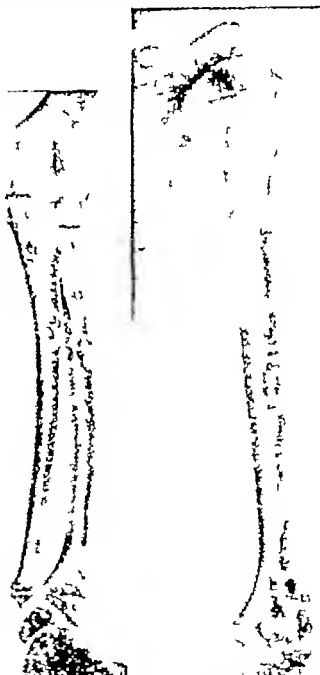


Fig 1

Fig 2

Fig. 1 (Sorrel and Quénu). Left forearm, radius affected in its whole length, with little involvement of elbow; however the superior apophysis is spotty and insertion of the anterior brachial muscle seems opaque. Lower end of the humerus is affected in its lateral half.

Fig. 2. Left humerus. Irregular densities of the lateral corticalis. Spots at the superior end of the humerus.

period of years. Signs of scleroderma in the affected areas were observed in both cases. In contrast to the classical picture both cases involved more than one limb. In one case both arms were affected in the other roentgenograms revealed that the bone lesions were multiple and widely scattered, with involvement of the left arm, the pelvis, both tibiae femurs and the right metatarsus.

The etiology and pathogenesis of the condition are unknown. Many hypotheses have been presented. In view of biopsy findings and of the coincidence of this bone dystrophy with skin and connective tissue disturbances, the authors suggest that melorheostosis may be closely related to neurofibromatosis.

WARREN M. SOLMITZ, M.D.

**Localized Osseous Lipoidosis (Lipoidosis osseae localis)** C. CASUCCIO and G. GHERLINZONI. *Chir. org. mod.* 948, 32, 7.

A 53 year old woman had suffered attacks of pain in the right hip for 15 years. Two years previously tumefaction of the right hip region was noted. A month previously the pains became severe and continuous, and began radiating along the course of the sciatic nerve. Roentgen examination disclosed large roundish, clear-cut shadow defects resembling cystic formations with sharply defined, dense borders. These shadow dehiscences occupied the neck of the femur, the epiphysis, the floor of the hip joint socket and even extended over into the neighboring osseous substance of the pelvic bone. The lower arched portion of the femoral neck leading down to the diaphysis exhibited the normal trabecular structure of nor-

mal bone. Some of the shadow defects were confluent, while others were separated by more or less delicate septal structures. The areas of deossification at no place encroached upon the heavy cortex of the femoral diaphysis. It is this roentgen picture which led the authors to suggest that the roentgen findings might be sufficiently characteristic to be of differential diagnostic value (Fig. 1) especially in distinguishing this localized condition from Recklinghausen's osteitis fibrosa with which condition it is most often confused.

Operation which included a disarticulation of the hip joint, uncovered the yellowish-orange colored masses characteristic of the lipoid tumor in which the type of lipoid present is cholesterol (Hanz-Schneider-Christian disease). Some of the masses were removed and an arthrodesis was done with the use of the greater trochanter as a transplant. Two months later the transplant was found to have healed in well the patient had not suffered any further pain or other discomfort and the appearance indicated that considerable reossification had taken place in the lacunar areas (Fig. 2).

Histologic examination of the excised specimens showed the typical picture of lipoidosis with the nests and infiltrations of the spumous cells interspersed among the masses of cells with the same general



Fig. (Casuccio and Gherlinzoni)



Fig. 2. (Casuccio and Gherlinzoni)

characteristics but without the eccentric nuclei copious cellular protoplasm and foamy appearance of the true spumous cells. The peripheral areas indicated a more active, hypervascular condition than the more storage-cell like appearing central areas. Papanicolaou's silver impregnation stain indicated a heavier than normal contingent of collagenous fibrils. These fibrils were arranged in a closely felted rete and were often irregularly dilated into a bulbous appearance or were tortuous in course. This appearance was repeated in many of the haversian lacunae of the neighboring bony tissue and there was no evidence of a well developed capsule between bone and tumor masses. In fact, the whole picture indicated that the process had originated in the endothelioreticular tissues of the haversian canals.

The patient died of an intercurrent malady before the authors were able to establish the character of the lipid present as cholesterolin however they believe that the nature of the fatty substance concerned was sufficiently established and if this is so this seems to be the thirty fourth instance of the localized form of Hand-Schüller-Christian disease to be reported in the medical literature.

JOHN W. BRENNAN, M.D.

**Neuralgic Amyotrophy The Shoulder Girdle Syndrome.** M. J. PARSONAGE and J. W. ALDEN. *TURNER, Lancet* Lond. 1948 1 973

The authors present a group of 136 cases of a syndrome consisting of pain and flaccid paralysis in the shoulder girdle muscles without constitutional symptoms. These cases were observed during the period from 1941 to 1945 in the British Army at home and in India.

The clinical picture is one of sudden acute pain across one or both shoulder blades which may radiate into the neck or arm. After a period varying from hours to days the pain is replaced by atrophy and flaccid paralysis of one or more muscles. There are many modifications of the clinical picture of the syndrome as a review of literature on the subject shows.

This group of cases was carefully analyzed from every angle and it is significant that 66 of the 136 patients were hospitalized for some other condition when the syndrome began. In 98 of the cases a possible precipitating cause was evident. In 71 patients the syndrome started during convalescence from an infectious process as malaria or minor fevers in 12 following simple surgery performed from 3 to 14 days previously. Minor trauma to various parts of the body occurred prior to the syndrome in 10 cases and various diagnostic procedures had been done previously in 5 cases. Only 67 of the patients were questioned concerning recent inoculations, and only 11 had such inoculations within the previous 4 weeks. One case developed in a man within 2 hours following the intravenous administration of typhoid vaccine to produce protein shock.

Fever and constitutional symptoms were notably absent and although local pain was the striking

symptom in most cases 2 men developed weakness and atrophy without pain. The pain usually decreased or left when weakness appeared. The location of the paralysis could not be forecast from the distribution of pain. Weakness was usually maximal at the onset but in a few cases progressed over a period of from 2 to 7 days.

The type of involvement suggests that the pathologic process may include not only one or more peripheral nerves but the spinal roots and even the spinal cord. The serratus magnus is the muscle most commonly involved either alone or in combination with the deltoid, spinatus or thumb and index finger flexors. In 58 cases there were objective sensory changes on examination, which were usually slight and included all forms of cutaneous sensibility. There were 39 cases in which both sides were affected occasionally with an interval between onset of the paralysis on the second side.

No specific treatment is known and these cases were managed much as cases of poliomyelitis. The prognosis is based on the same principles as that in poliomyelitis.

The etiology is unknown. Absence of constitutional symptoms lessens the likelihood of the conditions being a virus infection. The condition is very similar to that known to complicate the injection of serum occasionally.

The authors suggest the name 'neuralgic amyotrophy' as most accurate in the light of present knowledge of the condition.

FRANCIS E. BRENNICEK, M.D.

## SURGERY OF THE BONES, JOINTS, MUSCLES, TENDONS ETC

**Reconstruction of the Elbow Joint.** EDWARD PARSONAGE. *J. Bone Surg.* 1948 30-A 753

After discussing the various methods of reconstruction of the elbow and their disadvantages the author presents a revised medial approach for this procedure.

A semicircular incision 5 inches long is made over the medial aspect of the elbow. The ulnar nerve is identified freed from its bed and retracted with tape. The medial epicondyle is osteotomized and discarded. All soft tissues about the lower end of the humerus and including the humero-ulnar ligaments are cut by sharp dissection in enable complete exposure of the joint. At the completion of the skeletal repair the ulnar nerve is transposed anteriorly and subcutaneously the muscles are approximated and the wound is closed. A hanging cast may be applied for one week.

Even patients have been operated upon by this method. Six patients sustained severe fractures caused by missiles. One developed aneurysmal arthritis following a simple fracture of the lower end of the humerus.

The postoperative results are classed as firm ankylosis in 6 cases, and unstable elbow joint in 1 case. SAMUEL L. GOVERNALL, M.D.

**Coracoclavicular Joint. Surgical Treatment of a Painful Syndrome Caused by an Anomalous Joint.** LUIS GUSTAVO WERTHEIMER. *J Bone Surg* 1948 30-A 570.

Proved cases of an anomalous joint between the coracoid process of the scapula and the clavicle have been reported 50 times. Often the condition has existed but has not caused symptoms. Osteoarthritis was demonstrated in a painful case which improved after resection of this joint. Apparently trauma or arthritis cause the joint to be a source of pain.

The author describes a patient who 3 years before had strained his shoulder. He developed pain in the shoulder which radiated to the arm. He had been unable to work for 2 years. There was limitation of abduction flexion and external rotation, and these motions were painful. There was tenderness in the deltoid area. Conservative treatment gave no relief and no pathology other than that the coracoclavicular joint could be demonstrated.

After resection of this joint, painless normal function was established. NEWTON C. MEAD, M.D.

**Internal Fixation for Lumbosacral Fusion.** DON KIRK. *J Bone Surg* 1948, 30-A 560.

The lumbosacral fusion described in this article is performed after subperiosteal exposure of the spinous processes, the laminae and the articular facets of the vertebrae to be fused. The facets are exposed easily by the use of a Bennett retractor with a notched tip. The tip is placed against the lateral mass of the first sacral vertebra and the soft tissues are pried laterally. The articular surfaces are removed with a special osteotome which is curved to fit the curve of these joints. The spinous process of the fifth lumbar vertebra is removed. A No 31 drill is used to make a hole downward and outward parallel with the inferior border of the lamina at an angle of 45 degrees. This crosses the articulation and is a tunnel for the screw. A 1 inch screw is used in male patients and a 3/4 inch for females.

Numerous small grafts are elevated from the fifth lumbar laminae and the sacrum and grafts from the ilium are arranged against the raw surfaces. Sometimes a tibial graft is fastened by means of screws to the remains of the spinous processes of the vertebrae and sacrum.

There have been a wound infections requiring removal of the screws, and in 1 case a screw caused nerve root irritation. There were no deaths in the series reported. Definite pseudarthrosis developed in 9.1 per cent of the cases, but the clinical results were about as good in these as in those of patients who obtained solid fusion.

Based on his conclusions on 44 patients who were operated upon during the years from 1940 to 1945 the author believes this method of fusion is superior to methods which do not firmly fix the position and relationship of the bones at the time of operation. There is no need for prolonged immobilization in plaster postoperatively and the patients are comfortable. NEWTON C. MEAD, M.D.

**Radical Operative Treatment of the Tuberculous Hip. A Report of 113 Cases.** ALBERT ARMAND. *J Bone Surg* 1948, 30-A 550.

This report is based upon end-result studies of 113 proved tuberculous hips operated upon during the years from 1929 through 1944. These surgically treated hips represent 15.6 per cent of a total of 87 tuberculous hips treated during that period.

The operation is done through a superior-anterior approach, but the periosteum is not stripped from the ilium because it is believed that the circulation of this bone should not be impaired. The hip is dislocated and all capsular tissue is excised. Sinus and abscesses are excised if possible and curetted to healthy bone. No grossly diseased tissue is left. The raw surfaces are then cauterized with phenol and alcohol, the femoral head is placed in the acetabulum and the wound is closed.

If destruction of the head and neck of the femur is massive the trochanter is transplanted into the acetabulum. Sometimes extra-articular fusion is done in conjunction with resection. Eleven such cases are reported.

Operative findings included 63 abscesses, 50 acetabular sequestra, and 26 sequestra in the femoral head and neck. The process had perforated from the acetabulum into the pelvis 34 times, and the capsule was found grossly thickened in nearly all cases. In none of the cases was it found necessary to give blood transfusions postoperatively.

Primary healing occurred in 64 of the patients and 22 developed well established fistulas. There were 5 deaths occurring within a short time of the surgery.

The postoperative care averaged about 6 months. The patients were kept in bed in plaster for 3 months, but motion of the knee was permitted after 4 weeks. After a period of 3 months a short (knee length) unilateral hip spica was applied and crutch walking was begun.

It is interesting to note that only 8 of the patients had bony ankylosis at the time of discharge, but they were all bearing weight and walking. In a late follow-up 58 of the hips were found to have fused. It should be mentioned that in the early years of the series early motion was permitted because bony ankylosis was not desired by the surgeon at that time.

Another cause of failure of fusion was the necessity of removing large amounts of bone and in some cases the disease continued to destroy bone. An extra-articular fusion can be done later if fusion is considered necessary. Some patients developed painless motion and fairly good function but it appears that the author favors fusion as being the best result obtainable after this surgery.

The author's indications for resection of the joint in tuberculosis of the hip are

- 1 Abscess formation.
- 2 When fistula formation appears imminent.
- 3 The formation of sequestra.
- 4 A tendency toward subluxation or dislocation.
- 5 The patient should be 16 years of age or older.

NEWTON C. MEAD, M.D.

## FRACTURES AND DISLOCATIONS

Fracture-Dislocation of the Hip Joint. The Nature of the Traumatic Lesion Treatment, Late Complications, and End Results. MARSHALL R. URIST. *J Bone Surg* 1948, 30-A 699.

The author reports on 27 cases of dislocation of the hip associated with major fractures of the acetabulum or head of the femur with a 2 year follow up studies. In 15 cases open reduction was performed and the nature of the injury surveyed.

Injury to the rim of the acetabulum inflicted by a sudden impact of the dashboard against the flexed knee constituted the first stage of a fracture-dislocation. The damage to the posterior rim varied in magnitude from insignificant bruises or chip fractures to fractures of great segments of the entire posterior and superior portions of the acetabulum. Less than half the head of the femur lies outside the bony acetabulum in the normal hip so after many of the supporting structures in the capsule have been ruptured the integrity of the posterior and superior portions of the rim appear to be of increased importance to the stability of the hip.

The major damage to the soft parts of the joint was usually sustained by the parietal or external portion of the capsule rather than the visceral or reflected part which carries the major portion of the blood supply to the head of the femur. When a large segment of bone was detached from the rim the capsule was essentially intact except for a single tear in the posterior portion. The short external rotators however, sustained considerable damage. The belly and tendon of the piriformis were stretched over the head of the femur. The tendon of the obturator internus was stretched over the neck. The gemelli were torn and shredded. All of these structures were infiltrated with blood and matted together with fibrinous exudate and granulation tissue dissection was difficult if operation was done longer than 2 weeks after injury.

Almost every case showed some damage to the articular surface of the head of the femur but these lesions were small and not visible roentgenographically. Even fractures of some magnitude could not be demonstrated in anteroposterior views alone, or in films made by routine or imperfect techniques.

In 3 cases in which the posterior portion of the acetabulum had been removed the ligamentum teres was found to be stretched and frayed. Complete visualization was possible in only 2 cases in which the hip had been disarticulated and in both instances the ligamentum teres had been severed. It is possible that in one case it was stretched and not torn apart, and that in many cases the excursion of the head was not so great as appeared in the roentgenograms.

Blood clot and organizing hemorrhage were seen in the retinacula in 2 cases. One year later only these 2 cases showed disintegration of the bone structure of the superior portion of the head of the femur. The retinacula serve as aqueducts carrying blood to the

head of the femur. They are little mentioned in the literature but are important and their role in avascular necrosis demands further study in relation to both trauma and disease of the head of the femur.

In 15 cases of fracture of the rim of the acetabulum with dislocation the dislocation was reduced by closed manipulation just as readily as were the dislocations without fractures treated earlier by the author. In about 25 per cent of the cases the diagnosis of fracture was not recorded by the surgeon who first treated and manipulated the dislocation. The fracture is best seen in a postero-oblique view with the injured side elevated 60 degrees the patient lying supine on the cassette which places the posterior portion of the acetabulum in profile. Ten of these patients were treated by closed reduction of the dislocation followed by arthrotomy. The decision between replacement and fixation of the fracture or the removal of the fragments was made at operation and depended upon the presumed vitality of the bone fragments. The operation itself was always indicated when there were loose fragments around the joint which might lead to migration of intra-articular bone ossification of periarthritic structures irritation of the sciatic nerve, or the probability of a painful joint in later years. The technique of operation is described in detail.

There were 8 cases of fracture of the acetabulum with posterior dislocation irreducible by closed manipulation. This was due to interference by displaced bone fragments. Conservative treatment in traction was of limited value in these cases but it was essential for the patient's comfort and it was necessary temporarily to retain anatomical approximation of the head of the femur and the fractured pelvis.

In 4 cases there were gross fractures of the head of the femur associated with dislocation of the hip. Three patients were treated conservatively. One patient showed appreciable limitation of motion of the joint under anesthesia after the dislocation had been reduced therefore an arthroplasty was performed.

The early complications encountered in this series of cases were retroperitoneal hemorrhage injuries of the urinary tract thrombosis of the hemorrhoidal veins thrombophlebitis sciatic neuritis and palsy of the sciatic nerve. Late complications included ossification of the joint capsule synovitis, avascular necrosis of the femoral head, and traumatic arthritis.

The 2 year end results are given in detail. The author concludes:

1. Fractures of the posterosuperior rim of the acetabulum with displacement should be repaired as carefully as any other fracture of a weight-bearing joint.

2. Fractures of the posterior rim of the acetabulum associated with dislocation of the hip should be treated by cautious closed manipulation followed by open reduction and internal fixation of the fracture through a posterior approach.

3. Dislocation of the hip joint associated with comminuted fracture of the acetabulum should not be subjected to closed manipulation.

4 Fractures of the head of the femur except in cases in which it is necessary to reduce the size of the head or to excise the intra-articular fragments are best treated by conservative methods.

5 Degenerative arthritis may be expected to occur in most cases in which the superior or weight-bearing surface of the head or the superior rim of the acetabulum is defective and in many cases in which fragments of cartilage and bone are not cleaned out of the joint by operation.

J M J CRANE, JR, MD

### ORTHOPEDICS IN GENERAL

An Evaluation of Penicillin Therapy in Acute Hematogenous Osteomyelitis. W A ALTMEIER and C L WOODWORTH. *J Bone Surg* 94B 30-1 1957

The efficacy of penicillin therapy has been studied among 71 cases of hematogenous osteomyelitis during the last 4 years. Six hips, 6 knees and 1 ankle joint became secondarily infected by contiguity. Sixty three or 90 per cent of the patient were 30 years old or less. Fifty five (77%) of the patient were males and 16 were females. One of the frequency the portals of entry of the hematogenous infection were furunculid infected cutaneous abscesses, upper respiratory infections, suppurative otitis media, infected teeth, gingivitis, parotitis, chicken pox and scarlet fever.

In 70 per cent of the cases the offending organism was the hemolytic *Staphylococcus aureus*.

While the usual dose of sodium penicillin was between 15,000 and 25,000 units. Later in the study a high as 100,000 units were given either parenterally or intramuscularly every 3 to 5 hours. The results were extremely satisfactory. All of the patients recovered with the exception of one. The patient entered the authors' service in a moribund state suffering from an acute hematogenous osteomyelitis of the tibia with staphylococcal bacteremia, and died 17 hours after admission. Obviously the results vary with the severity of the infection, the dosage of the penicillin and the commencement of treatment. Excellent results were obtained in patients in whom the diagnosis was made and penicillin therapy initiated within 6 days of the onset of the disease. Poorer results were noted in cases in which the treatment was not instituted until 7 days or more after the onset of the disease. To enhance the excellent recoveries of hematogenous osteomyelitis the authors have observed the necessity of immobilization, prevention of weight bearing and latent or delayed surgical drainage of large osteomyelitic abscesses.

Nine recurrences have been noted in 67 follow-up cases. The majority of the recurrences are attributed to insufficient treatment. Larger doses of penicillin decrease the morbidity and duration of the stay in the hospital and augment the therapeutic efficacy.

The authors have pointed out that since the hemolytic *Staphylococcus hemolyticus*, *Streptococcus*,

nonhemolytic *Streptococcus*, and *Pneumococcus* are extremely sensitive to penicillin early administration should prevent the extensive thrombosis of the nutrient vessels with periosteal stripping, and lower the previous mortality of 25 per cent to a new low of 1.4 per cent as attained in their series. To avert serious complications the surgeon or the family doctor must make the diagnosis early and on the basis of the clinical manifestations of osteomyelitis. Delay of from 10 to 14 days to await roentgenological evidence of bony lesions invites irreversible pathological changes.

Early decompression of infected bone was not practiced in this series. Adequate and early administration of penicillin obviates the necessity of surgical intervention in osteomyelitis. Sequestration was observed in 6 cases only.

S MUEL L. GOVERNALL, MD

Functional Substitution in Irreparable Radial Nerve Palsy (Der funktionelle Ersatz bei der irreparablen Radialislähmung) ALFRED NIKOLAI, W RT (Chirurg) 94B, 0 67

The author discusses his experience with the surgical treatment of 200 patients with radial nerve palsy. There were 125 treated according to the classical Perthes procedure and 135 treated by an extensor tendon plastic procedure which consisted of transplantation of the flexor carpi ulnaris and radial muscles without tenodesis. The simplified Perthes plastic procedure of Bauer was also taken into consideration.

The classical Perthes procedure consists of (1) tenodesis of the extensors carpi radialis brevis and longus through a canal in the radius, and subperiosteal fixation of the extensor carpi ulnaris to the ulna and (2) transplantation of the flexor carpi radialis and ulnaris and the palmaris longus to the extensor tendons.

The extensor tendon plastic procedure avoids fixation of the wrist by tenodesis and depends upon dorsal transplantation of the flexor carpi radialis and ulnaris. In the event that the palmaris longus is well developed it may be used in place of the flexor carpi radialis.

Bauer operation consists of dorsal transplantation of the flexor carpi ulnaris and suture to the distal ends of the sectioned extensor digitorum communis tendon in order to obtain extension and suture of the proximal ends of the sectioned extensor tendons to the dorsal carpal ligament in order to eliminate wrist drop by a braking action. The author has used this method in a few cases.

A consideration of the comparative value of the three procedures cannot be based on technical simplicity, but rather must depend upon a critical evaluation of late results. The author believes that when certain prerequisites are fulfilled the classical Perthes procedure is the best method. By tenodesis the greatest danger, namely overstretching of the transplanted muscles, is eliminated. The objection that tenodesis causes a loss of wrist flexion is correct.

but this is compensated for by greater mobility and play in finger movements which results from the fact that a part of the muscle power is not used to fix the wrist. The amount of dorsiflexion procured by tenodesis can be adapted to the needs of the individual patient. Dorsal fixation of the wrist by tenodesis provides the three wrist flexors for transplantation which appears to be of greater value than transplantation of one or two flexors, especially with respect to thumb extension and abduction.

Contraindications for tenodesis are (1) the presence of marked limitation of movement at the shoulder or elbow because a slight amount of wrist motion is of the greatest importance in these cases (2) contracture or ankylosis of the wrist joint to the extent that a frank wrist drop is not present (3) the expressed wish of the patient not to have the wrist fixed and (4) occupations which require predominating function of the wrist in flexion.

The extensor tendon plastic procedure is a good one under sharply circumscribed indications. It is performed when one of the contraindications to tenodesis is present and is the procedure of choice in partial radial nerve paralysis when wrist extensor function is preserved. In a few selected cases in which strong wrist flexors are present, tenodesis can also be dispensed with. The deficiencies of the extensor tendon plastic operation for other cases result from a division of the power of the transplanted muscles between maintaining wrist extension and providing finger function which is detrimental to the latter. Further the position of the wrist may gradually return toward flexion so that the power of grip is lost. The differentiated movements of the fingers cannot in most cases compare with those obtained by the Perthes classic operation, and the function of the thumb cannot be restored as favorably because the palmaris longus is not used for the isolated substitution of the extensor pollicis longus. In hard working men the substituted muscles are liable to overstretch in the absence of tenodesis. In spite of these deficiencies the extensor tendon plastic operation often shows astonishingly good early results but as time goes on it brings disappointment unless strict indications are observed.

The author objects to Bauer's operation on the following grounds (1) only one muscle is transplanted so that power and function do not compare with those obtained by the transplantation of two or three muscles (2) a good functional result depends upon restoration of thumb function which is not obtained by this method (3) suture of the proximal ends of the divided extensor tendons to the dorsal carpal ligament in order to provide braking action is an inadequate tenodesis because the ligament is already overstretched in most cases of wrist drop because the ligament does not provide a fixed point for tenodesis, and also because the tenodesis becomes overstretched with active hand flexion. The transplanted flexor carpi ulnaris must therefore maintain both hand position and finger function.

JOHN L. LUNDQVIST M.D.

Observations and Experiences with Tenoplasties for the Improvement of Function in Wrist Drop (Beobachtungen und Erfahrungen bei Sehnenplastiken zur Verbesserung der Funktion der Fallhand)  
HERBERT HERBIG *Chirurg* 1948 19 171

Although the results of Bauer's operation for radial paralysis appear to be good and the technique simple the procedure lacks a certain advantage that Sudeck's operation has namely provision for the recovery of radial nerve function and reinnervation of the extensor muscles. Perthes' operation likewise makes no provision for radial nerve regeneration. It is important to carry out early operation in these cases before it can be known whether or not radial nerve regeneration will occur. The author believes that too much value has been placed on rigid tenodesis by Perthes and by other authors in the past and that a more elastic tenodesis as proposed by Bauer is desirable.

The author describes a procedure he used in 4 cases of wrist drop as well as the results obtained in 8 cases treated by Bunnell's method. The author's procedure is recommended especially for cases in which there is a well developed flexor carpi ulnaris muscle. He used a tendon-stripper to isolate the tendons. The flexor carpi ulnaris is isolated and transplanted to the dorsal aspect of the forearm through a channel. Its tendon is then passed through slits made in the tendons of the extensor digiti proprius, the extensor digitorum communis, extensor indicis proprius and extensor pollicis longus and sutured at these slits. The extensor tendons are not cut through. The hand is splinted in dorsiflexion with the fingers in extension for 3 weeks. Because a slight ulnar deviation of the wrist occurred in 2 cases the author added a tendon anastomosis between the flexor carpi radialis and the extensor pollicis brevis and abductor pollicis longus in the fourth case. Ulnar deviation of the wrist did not occur in the last case. The results in 3 cases were satisfactory and in 1 case good. The patients could maintain the hand in balance with extended fingers. There was active dorsiflexion at the wrist of from 20 to 40 degrees and extension of the thumb to 45 degrees. There was powerful closure of the fist with the wrist in dorsiflexion. The period of observation was limited to from 6 to 8 weeks following the operation.

The author reports 6 good results in 8 patients treated by Bunnell's method. In 2 cases abduction of the thumb was unsatisfactory but otherwise the results were good.

In the treatment of wrist drop due to radial paralysis several operative procedures are available ranging from the pure tenoplasty of Bunnell and others to the elastic tenodesis of Bauer and of Sudeck, to the rigid tenodesis of Perthes or to a combination of arthrodesis and tenoplasty. For long-standing cases of paralysis with frank muscular atrophy Perthes' procedure is the only one of value. In cases of recent paralysis with well developed muscles of the arm other procedures should be given more consideration.

JOHN L. LUNDQVIST M.D.



Experimental Intervertebral Disc Lesions. J. ALBERT KEY and LEE T. FORD *J Bone Surg* 94B 30-A 62

Fourteen dogs were anesthetized and, in each, 4 adjacent discs were exposed. The most caudal disc, usually the seventh lumbar, was designated as Disc 1 and those above it were designated as Discs 2, 3 and 4, respectively.

In Disc 1, by the use of a small tenotomy knife, a square window including the posterior longitudinal ligament and the annulus fibrosus, was removed from the left side of the posterior aspect of the disc. With a small curette, the interspace on the left was vigorously curetted until it bled. The nuclear material and cartilage thus loosened were removed with the curette and with suction. In Disc 2 the same procedure as in Disc 1 was used except that the space was curetted gently and no attempt was made to break through the cartilage plates of the vertebrae. In Disc 3 with the tenotomy knife, an incision was made transversely in the posterior longitudinal ligament and annulus fibrosus on the left side. Some nucleus pulposus material extruded but the disc was not curetted. In Disc 4 a 20-gauge needle was pushed through the annulus fibrosus into the interior of the disc. Spines were obtained from the dogs at intervals varying from 2 days to 28 weeks after operation.

In each Disc 1 (except one) and in each Disc 4 collapse of the disc and narrowing of the disc space were visible in the roentgenograms and in the sagittal sections of the gross specimen. In the latter the soft bulging nucleus was not present in the older experiments the nucleus was replaced by fibrous tissue. The adjacent nerve roots were adherent to the discs operated upon in every instance and these adhesions were more dense in the experiments of longer duration. In 6 of these roentgenograms, damage to the bone by the curette was visible at Disc 1. Moderate or slight protrusion of the disc

substance at the site of the operative defect was present in 7 of the first discs and 8 of the second discs. In the remaining 13 first and second discs of this group the defect in the annulus was obliterated by fibrin or fibrous tissue and the site of the operative defect was level with or depressed into the disc space.

In the third discs, the incision was found to be closed by fibrin in the dogs sacrificed early and by fibrous tissue in those which had lived long enough for this tissue to form but in the dogs which lived 20, 21, 22 and 28 weeks, a well developed rupture and a protrusion of the nucleus pulposus were found.

In Disc 4 in one instance, a small but definite and characteristic posterior herniation and protrusion of the nucleus pulposus was found at the site of the needle puncture. The adjacent nerve root was slightly adherent to this disc protrusion, and there was slight collapse of this disc with narrowing of the intervertebral space. In the other 13 specimens, there was no definite collapse or narrowing at Disc 4.

Microscopically it was noted that the annulus fibrosus had a very poor blood supply, and that the defects in it tended to heal at the surface while the operative defect in the deeper layers tended to remain open for a long time.

The production of posterior protrusions of the nucleus pulposus appeared to be a slowly progressive phenomenon. The earliest well developed protrusion was noted in a specimen removed 20 weeks after operation.

In none of the experiments was bony ankylosis produced between the bodies of the vertebrae.

The experiments suggest that the primary lesion which leads to a protrusion of an intervertebral disc is a weakening of the posterior portion of the annulus fibrosus. This may be due to degenerative changes or to injury. The degenerative changes in the nucleus pulposus appear to be secondary.

JORDAN J. CRANLEY, JR., M.D.

# SURGERY OF THE BLOOD AND LYMPH SYSTEMS

## BLOOD VESSELS

The Treatment of Spontaneous Prescalenic Aneurysm of the Subclavian Artery (A propos du traitement de l'anéurysme présclénique spontané de la sous-clavière) RENE LERICHE. *J. chir. Par.*, 1948, 64, 81

The author describes in detail an interesting case of aneurysm of the right subclavian artery in a patient suffering from recurring rheumatic fever. The aneurysm was felt as a pulsating mass of hen's egg size. As it involved practically the whole length of the first portion of the artery, aneurysmorrhaphy was not practicable and the surgeon decided to ligate the subclavian artery.

An incision was made between the two heads of the sternomastoid muscle and the entire median portion of the scalenus muscle was severed. However, the artery coursed so far backward that it could not be visualized, and it was necessary to resect the medial end of the clavicle and to luxate the clavicle downward. The subclavian muscle was cut. Now the vertebral artery was visualized which proved to be greatly enlarged and larger than the subclavian. Ligation of the subclavian artery was done at the origin of the vertebral artery. Uneventful recovery followed.

The patient was seen again 13 months later. The aneurysm had grown slightly and was filled against

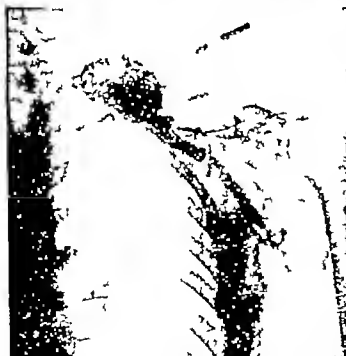


Fig. 1. Aneurysm before ligation. An internal mammary artery is seen originating from the sac inferiorly. A bifurcated vessel is superimposed on the sac, evidently the axis thyrocervicocapularis. The other arteries are not visible. Note the lateral diverticulum below the clavicle.



Fig. 2. The sac 16 months after ligation of the subclavian artery. The bilobate appearance is due to the presence of a voluminous mass of fibrin in its middle. The proximal end of the sac is well filled. The first portion of the subclavian artery having been ligated, the filling occurs against the current in a free canal between the clots and the wall of the sac where, normally, blood should pass. The internal mammary artery and a double cervical axis are well visualized.

the current from the axillary artery (Fig. 2). The collateral circulation and the function of the arm were perfect although no radial pulse was palpable.

Three months later, that is, 16 months after the ligation, the aneurysm was extirpated. A large trunk of the brachial plexus and the phrenic nerve were fused into the wall of the sac and had to be dissected carefully.

In discussing the case, the author believes that it would have been preferable to approach the subclavian artery by the transpleural route and to isolate it close to its origin.

WERNER M. SOLMITZ, M. D.

Progress in Vascular Surgery (Progrès dans la chirurgie vasculaire) R. LERICHE, *Lyon chir.*, 1948, 43, 134.

The author reviews the progress in the various fields of vascular surgery except that of cardioortic malformations in which he has had no experience. It is here that the operations of Gross, Alexander Crafoord and Blalock as well as those of Potts

Smith and Gibson have opened a new chapter on catheterization of the heart.

In cases of acute contusion with peripheral ischemia and absence of pulse arterial puncture is made to insure permeability and novocain is injected into the artery beneath the adventitia to produce a block of the sympathetic ganglion. This block is repeated every 6 hours until the symptoms subside. If however the artery is dilated and contains coagulations immediate arteriotomy is indicated and this is to be followed by repeated sympathetic block. In chronic contusion thrombectomy rather than arteriotomy is recommended.

Wounds from cutting instruments should be sutured, *ven* if the circular suture is necessary and should likewise always be followed by sympathetic infiltration or ganglionectomy. In war wounds of the arteries the arterial wound must be treated *per se*, and without consideration for satellite muscular bone or articular injuries. Arterial continuity must be restored whether by lateral or circular suture or ven by venous grafting. A more frequent use of sutures is desirable especially in cases in which ligature is dangerous such as in the primary carotid or common femoral artery but each case has its special indications. However ligature is still done in the majority of cases. Tuffier's intubation with the aid of heparin may be useful in some instances. The reason for the frequent failures of ligature is discussed. Sympathectomy may prevent fatal ischemia with subsequent gangrene. In some cases ganglionectomy is indicated, but the latter must be done promptly before ischemic symptoms develop. Following ligatures which render restoration of the circulation impossible as in the vicinity of a bifurcation, intubation may prove of value. Arteriotomy is therefore usually preferable to ligature. The lower lumen must be examined and if obstructed thrombectomy is indicated.

Aneurysms must be exactly located by arteriography before operation, and although conservative methods may suffice, it is best to prepare the collateral circulation by repeated sympathetic block, or in the larger arteries by ganglionectomy. Preliminary hemostasis is imperative. Digital compression of the governing artery can be definitely useful. In traumatic aneurysms with only one orifice the lateral transarterial angiorrhaphy of Matas is recommended. But, of course, all traumatic aneurysms do not have a single orifice and a lateral sac Endoaneurysmorrhaphy is preferable to excision. It is suggested that the ideal method might be an end-to-end suture following excision or graft. In spontaneous aneurysms with two orifices, the Matas transarterial obliterating angiorrhaphy is preferable to excision. If the aneurysm is at a bifurcation of the vessel it may be best to operate in two stages.

The recent operations of Alexander and Crawford have solved the problem of aortic aneurysm in cases with dilatation subjacent to an isthmic stenosis. In aneurysms above this point preparations for the establishment of a collateral circulation should be

made by a high lumbar or thoracic ganglionectomy. It might be best to make incomplete ligatures at first, to be completed after the collateral circulation has been established but this has been accomplished only experimentally and not in man. For aneurysms below the inferior mesenteric artery at the bifurcation one might completely ligate or divide the aorta without danger following lumbar sympathectomy removing the aneurysm in a second stage. Also derivation by intubation as suggested by Carrell might be tried.

Arteriovenous fistulas must be treated by correction of the short circuit by removal of the fistula. Excision between four ligatures is very well tolerated and may be supplemented by preliminary or subsequent ganglionectomy but this is necessary only in exceptional cases. The ideal method of treatment is by occlusive suture of the fistula after preliminary hemostasis according to Matas and Blekham. Carotid jugular fistulas are too high for suture and will require excision. The procedure is also indicated when there is a sac between the two vessels or an arterial dilatation on the side opposite to the fistula. In some cases the author has been able to resect the sac, placing an almost circular suture in the artery at the level of the tibioperoneal trunk.

For arterial embolism embolectomy is the procedure of choice but suture of the arterial wound must not be done unless the endothelium is normal. If not, arteriotomy is indicated. Since the advent of heparin embolectomy may be further delayed, and with the use of the Dos Santos deobstruction operation still further delay is possible, so that arteriotomy may soon be indicated only in exceptional cases. If symptoms are due to a small embolus they will subside following bilateral infiltration of the stellate ganglion and the intravenous injection of novocain. Should the symptoms persist a Trendelenburg operation should be performed promptly under local anesthesia.

For thromboarteritis obliterans the first intervention consists of high ganglionectomy and adrenal ectomy followed by ganglionectomy on the opposite side and arteriotomy. For arterial obliteration of the thigh arteriotomy of the iliac artery and the end of the aorta may be followed by ganglionectomy. In cases in which the leg is involved a low ganglionectomy is indicated. In recent obliterations, the author has had very successful results in 5 cases with the Dos Santos deobstruction operation. Nothing new has been added to the treatment of angioma or disoid aneurysm.

On the basis of the excessive growth of limb observed as a result of arteriovenous fistula in infancy the author is experimenting with the creation of a fistula between the superior femoral vessels to correct inequality in the length of the limbs in infants. He also suggests that the creation of an artificial fistula might relieve some cases of persistent hypertension, and that arteriovenous anastomoses might be used to revitalize certain tissues such as the glands of internal secretion. EDITH SCHWARTZ MOORE.

## BLOOD TRANSFUSION

Various Articles Concerning Blood Transfusion and Cardiovascular Disturbances in Surgery (Travaux divers sur la transfusion sanguine et les troubles cardio-vasculaires en chirurgie) A HUSTIN *J internat chir., Brux., 1947 1948, 7 & Supp*

The author, director of the surgical department of the municipal hospitals in Brussels, Belgium presents a review of the important work done by himself and his collaborators during the last 30 odd years. About 50 articles on diverse surgical and physiological subjects represent his lifework. In addition to a number of publications on various surgical questions his main interests and the researches of his service were concentrated on two subjects blood transfusion and cardiovascular disturbances in operations and surgical affections.

He claims to be the first to have performed a blood transfusion with citrated blood (on March 27 1914) several months before this method was published by Lewisohn and Weill in this country. The international discussion concerning the priority of the new method is reported in detail.

In 1937 the author described an apparatus devised to prevent clotting of the blood in the needle and rubber tube, and in 1938 a pump to be used in blood transfusions.

Several articles deal with the questions of transfusion reactions and the influence of the sexes of the donor and recipient on the frequency of their occurrence. In a series of 864 transfusions it was found that the incidence was lowest when both donor and recipient were males (5.3%) and highest when both were female (17.3%). In practice, therefore, it seems advisable to 'cross sexes in order to reduce the cases of untoward reactions. Another set of statistics covering 3881 transfusions proved that reactions of all kinds are not more frequent after the second and third transfusions than after the first one. The author concludes that, except for special indications the determination of the Rh factor is not necessary before transfusion.

Another large group of researches was devoted to cardiovascular problems. Changes of heart frequency during anesthesia and during surgical operations were studied by means of a cardi tachy meter. This instrument invented by the author registers automatically the R waves of the electrocardiogram and permits study of the changes of heart frequency during inhalation as well as during spinal and local anesthesia. Furthermore the influence of various surgical operations and nonsurgical factors (emotions cough, change of position) on the heart frequency were studied with the aid of this instrument.

In order to study the reactions of the vasomotor system under various conditions the author devised an apparatus which makes it possible to register

automatically and simultaneously the temperature of different parts of the body e.g. rectum hand and foot. Experiments on normal persons who were kept in bed revealed that the skin temperature of the extremities undergoes characteristic rhythmical changes during the daily cycle. During the night the temperature of the uncovered foot follows the rectal temperature closely. Around 5.30 a.m. the curve goes down brusquely by about 5 degrees centigrade and continues on this low level through the day only to rise again around 8 p.m. This typical curve is observed consistently whether the individual is awake or asleep.

Other studies deal with the effect of cooling of one member on the vasomotors of the contralateral limb the influence of tourniquet, of emotional stimuli of arterial embolism and other pathological factors on the skin temperature of the affected parts. Furthermore changes of skin temperature after sympathectomy and other neurosurgical interventions in chronic obliterating arteritis and intermittent claudication, in phlegmasia alba dolens during different types of anesthesia and operations were studied.

This short review gives only an incomplete picture of the many sided work of Hustin. His publications include a wide range of other subjects in surgery and anesthesiology. *WERNER M. SOEMMER M.D.*

A Study in Intravascular Thrombosis with Some New Conceptions of the Mechanism of Coagulation. HAROLD COMBES and RAYMOND N. LYONS. *Brit J Surg.* 1948 35 337

Postoperative thrombosis may be divided into three classes:

1. Immediate postoperative thrombosis (i.e. within 24 hours) presumably due to the formation of a considerable amount of intravenous thrombin during an extremely long operation by excessive tissue trauma.

2. Delayed postoperative thrombosis indirectly caused by the presence of fibrinogen B associated with venous stasis. These factors cause platelet disintegration and intravenous thrombin is formed. Stasis again plays a part in preventing the normal metabolism of the fibrin which is formed.

3. The mechanical detachment of embolic fragments.

Contributing factors in the second type appear to be pyogenic infection and/or tissue necrosis  $\rightarrow$  fibrinogen B in circulating blood + platelets  $\rightarrow$  increased platelet fragility + venous stasis  $\rightarrow$  intravenous thromboplastin  $\rightarrow$  intravenous thrombin (low coagulation time)  $\rightarrow$  fibrin + stasis  $\rightarrow$  thrombosis.

Both fibrinogen B and profibrin are factors which increase the blood sedimentation rate and thus their clinical determination are described.

*JOHN J. MAULSTY M.D.*

# SURGICAL TECHNIQUE

## OPERATIVE SURGERY AND TECHNIQUE POSTOPERATIVE TREATMENT

Movement of the Diaphragm after Operation JONES  
HOWARD. *Lancet* Lond., 948, 85.

The author investigated the high incidence of chest complications after operations for hernia in a group of 135 young army personnel. Preoperative and postoperative medication was standardized. One day prior to operation the vital capacity, the chest expansion and the diaphragmatic excursions were measured. These data were also obtained in the postoperative phase of each case. In this series spinal anesthesia was used in more than half of the patients. Nevertheless postoperative chest complications were as high as with any type of inhalation anesthetic.

The lower limit of diaphragmatic excursion was 1.5 cm. and the average 5 cm. The incidence of chest complications in association with a 5 cm. diminution of diaphragmatic excursion was 44 per cent, with a 3 cm. diminution 50 per cent, and with a 1 centimeter diminution 70 per cent. It was concluded, therefore, that the incidence of chest complications was associated with the postoperative reduction in diaphragmatic movement. It was not possible to determine whether restriction in diaphragmatic excursion caused atelectasis or whether the atelectasis preceded the inhibition in diaphragm movement. However radiologic evidence of diaphragm pathology was demonstrable before any clinical evidence of lung pathology. There was no specific relationship between the site of operation and the side of diaphragm involvement. In the majority of cases in this series the diaphragm was affected on both sides. Vital capacity was reduced postoperatively from 5 to 50 per cent. Not all cases with diminished vital capacity showed alterations in diaphragm excursion. The latter can be accounted for on the basis of compensatory activity by other respiratory muscles. Postoperative serial roentgenograms of the chest revealed that partial or complete atelectasis was confined to the lower regions of the lung. Apical lung changes were never observed.

The diaphragm is intimately co-ordinated with the intercostal muscles and the muscles of the abdominal wall all of which are innervated by the respiratory center. The fibers of the spinal cord, the thoracic nerves, and the phrenic nerve. In the erect position the abdominal viscera exert a negative pressure on the under surface of the diaphragm. In the supine position negative pressure is released and the diaphragm rises. The right hemidiaphragm averages 1.25 cm. higher than the left. The total excursion of both hemidiaphragms is approximately the same. The total excursion averages 1.25 cm. more in the supine and prone positions as compared with the erect, and averages 2 cm. less in the sitting position

as compared with the supine. With the patient on his side the diaphragm pivots about the spine, the upper hemidiaphragm moving slightly, the lower moving markedly.

A knowledge of the physiology of the diaphragm is of clinical value in postoperative care so as to increase diaphragmatic excursions and influence expansion of various parts of the lung. The sitting position or Fowler's position is considered detrimental for the postoperative case because of its effect on the diaphragm and lung. The abdominal wall should be permitted maximal freedom of action unhampered by tight dressings or abdominal binders. Full and free pulmonary ventilation can be obtained by encouraging active movement of the patient in bed and/or early ambulation. Attention to postural drainage should be directed toward the lung bases by elevation of the foot of the bed or by keeping the patient flat and getting him to turn from side to side. Patients should be taught to breathe correctly and preoperative and postoperative breathing exercises routinely enforced in the wards. All respiratory depressant drugs should be discontinued postoperatively and aspirin and bromides substituted as analgesics. Smokers should abstain from smoking for a few days preoperatively because of their predisposition to chest complications. In elective surgery the infective element can be reduced by delaying operation in patients with upper respiratory colds and the proper isolation of patients in surgical wards. In inhalation anesthesia, sterilization of the breathing apparatus is an important safety factor.

BENJAMIN G. P. SEAROTT, M.D.

## ANTISEPTIC SURGERY; TREATMENT OF WOUNDS AND INFECTIONS

Comparison of Crash Injuries in Man and in Laboratory Animals. ROBERT F. RUMMER and GEORGE M. HARR. *Am J Surg* 948, 76-84.

The authors compare observations made on humans beings coming to autopsy following aircraft accidents with the observations of lesions produced experimentally on cats, rabbits and mice. They selected 21 victims who had apparently been seated facing forward at the moment of impact of the aircraft in the ground. All of the victims of these crashes had been killed instantly with the exception of 6 involved in crash landings which occurred when the plane was moving between 50 and 90 miles per hour. A group of 9 victims were known to have survived long enough to reach a hospital. The duration of survival ranged from 15 to 80 hours.

Comparative experiments were done on anesthetized cats, rabbits, and mice by abrupt deceleration of the animals. In spite of many differences in the conditions obtained during the deceleration, the lungs revealed gross pathologic changes in more than

75 per cent of both the human beings and the experimental animals

In general, the types of lesions in the lungs, liver, spleen, diaphragm, kidneys, gastrointestinal tract, and pancreas were similar in man and the laboratory animal. The incidence and severity of the lesions were considerably greater in human victims who died instantly. Extensive trauma to the brain, heart, and great vessels was not observed in the experimental animals.

These findings indicate that direct experimentation on laboratory animals can be a valuable adjunct in the study of the mechanisms of production of internal injuries and possibly also in designing methods of protection against great decelerative forces.

LEROY J. KLEINBAUER, M.D.

**The Management of Whole Thickness Burns with Involvement of the Bones and Tendons.** HARVEY S. ALLEN, *Q. Bull. Northwest Univ. M. School* 1948, 22: 115

Whole thickness burns are often complicated by the involvement of bone or tendon within the depths of the wound. The neglect of closure of these open wounds has meant increased loss of protein and superimposed infection and frequently the patient is in danger of loss of limb or even life. Constantly added infection will mean an increase in destruction of the soft parts and also of the bone or tendon. The patient's condition will rapidly deteriorate in the presence of this infection. Weight loss, cachexia, extreme secondary anemia and hypoproteinemia rapidly develop. The patient's condition can be improved by the usual methods of proper diet, liberal use of transfusions of whole blood and by combating the infection with scrupulous aseptic care of the open wound. To restore these patients to a satisfactory status which allows closure by skin graft to the wound is a very real undertaking. When a planned attack in the care of these deep burns is utilized it is often possible to obtain early closure in from 10 to 14 days after the injury. However there must be a minimum of delay between the time of removal of the burn slough and the application of the skin graft. If at the time of skin grafting the tendon still retains its sheath or its normal color a split graft applied over it will heal satisfactorily. It will at least seal the wound from subsequent infection. This is also done when exposed bone has retained intact periosteum. If the tendon is necrotic or has changed color to yellow or black excision of the necrotic portion is essential before a graft will survive over it. When it is obvious that the exposed bone has lost its periosteum or if it has become infected then a skin graft will not heal over it. Also it is inadvisable to attempt to remove dead and infected bone down to healthy tissue. Sufficient time must be allowed to elapse for the infected bone to sequestrate. The adjacent soft tissue wound should not be ignored or neglected while the demarcation of bone or tendon is taking place. The soft tissue wound itself should be closed by skin grafting up to the site of necrotic bone or tendon. After se-

questration of these structures has occurred the remaining small wound may be grafted and closed.

FRANK F. KAMTIAK, M.D.

**Reconstruction of the Burned Hand.** RADFORD C. TANKER, *England J. M.*, 1948, 235: 687

Reconstruction of the burned hand starts at the time of the initial dressing. The immediate local treatment of a burned hand includes a minimal débridement confined at most to the removal of blisters and the application of a firm even pressure dressing. The fingers are dressed individually and the hand is held in the position of function.

The method of immediate or early excision of severely burned areas and replacement with free skin grafts rarely applies to the burned hand because of the anatomical features of the hand with its dearth of subcutaneous tissues. Such a dissection would leave important structures such as the tendons and aponeuroses of the fingers for the bed of the graft. Pyruvic acid paste or moist dressings may be used to prepare the wound for grafting.

Any granulating area should be resurfaced as soon as the nutrition of the wound permits. Early mobilization as early as possible, to minimize edema and maintain joint action should be started even before the grafts are stabilized. This is the best time to correct incipient contractures by proper positioning of the digits on a splint with gentle elastic traction at strategic points to maintain the functional position. Once the skin is stabilized one can start occupational therapy and await softening of the scar before considering a more permanent replacement. Often no further replacement will be necessary.

In the later reconstruction one should be sure the process has become stationary. One type seen is the spotty depigmentation of the dorsum which may offer sufficient reason for replacement. Hypertrophic keloid is a common late complication.

The principal indication for resurfacing is the presence of a constricting or an unstable scar. A most satisfactory type of graft is of nearly full thickness which is dissected from the abdominal wall; however it is time-consuming and requires an extensive procedure so for expediency the dermatome or free hand split thickness graft is usually employed. The method employed in resurfacing the dorsum of the hand is described.

Direct pedicled flaps are advisable when tendons or joint capsules are involved and may require further reconstructive work. Burns to the volar surface of the hands if deep present baffling problems in restoration. Occasionally free grafts will suffice if the tendon sheaths are preserved but otherwise the pedicled grafts will be required.

Residual joint contractures may be produced by either the lack of splinting or improper splinting either of which may result in complex contractures of the digits. These deformities may be corrected by elastic splinting or if this fails by capsulotomy.

Flattening of the thumb with adduction contracture may be minimized by early and effective splint

ing, provided the muscles have not become shortened or fibrotic. If the contracture is of long standing the condition can be improved by detaching the adductors from their insertion distally and reattaching them proximally on the metacarpal to deepen the web and permit the thumb to fall into a more abducted position.

HARVEY S. ALLEN, M.D.

#### Postoperative Illness (La malaltia postoperatoria)

FRANCO B. ARCEL. *Arch. Ital. Med. Hyg. Diet.* 1948, 4: 77

Any surgical intervention however minimal produces in the organism a series of local and general alterations which constitute postoperative illness, *malaltia postoperatoria*, a term introduced by Leicbe in 1934 to indicate this syndrome. The symptoms may be mild or grave. In the mild form one sees general malaise, dryness of the mouth, thirst, vomiting, anorexia, paralysis and distention of the intestines, mild hypotension, oliguria, insomnia, psychic agitation and genital disturbances. In the more severe grade there are two forms: a precocious form (shock) and a late form (toxic) with correspondingly more severe symptoms.

Review of the literature reveals at least eight theories on this postoperative illness, to which the author adds a ninth based on the anatomy. This theory of Antonucci *et al.* contends that the anatomical lesions, however small, in the various organs, especially in the liver and kidney, may be the basis for the postoperative neurohumoral syndrome. Antonucci observed that when aspiration was done following gastric resection there were no toxic manifestations or elevation of the blood nitrogen. Research by his students consisting of injecting rabbits with fluid withdrawn from the stomach 24 hours after resection showed marked toxicity in these animals. Histology showed marked congestion, hemorrhage, anemic and hemorrhagic infarcts, and necrosis in the internal organs, especially in the liver. The work of Roger and Garnier on normal gastrointestinal liquid is mentioned. These authors concluded that normal gastric juice was mildly toxic while the fluid from the intestine was much more toxic, that from the small bowel being more toxic than that from the colon.

The authors performed experiments by injecting fluid aspirated from patients who had had a Reichel Polya gastric resection from 20 to 24 hours before. This fluid was collected with aseptic precautions passed through Chamberland and Berkefeld filters, and then injected into the marginal vein of the ear of rabbits in varying doses. Five different groups were used. It was concluded that gastric retention following gastric resection is very toxic and that systematic aspirations one or more times a day should be made in the period immediately following operation. The fluid aspirated after the first 24 hours is less toxic. If the aspirated fluid is kept at ambient or atmospheric temperature the toxicity also diminishes. It was also found that gastric juice from normal patients or those with peptic ulcer was

not toxic or only mildly so even after the injection of 1 mgm. of histamine.

The toxicity is believed to be due for the most part to histamine and also to other substances such as polypeptides and peptones.

The anatomicohistological lesions are caused by alterations in the circulation and blood and consist essentially of thromboses and cloudy degeneration most marked in the liver and kidneys.

LUIGI J. FROVOTTI, M.D.

#### ANESTHESIA

Trends in Regional Anesthesia. CARL S. HELLMUTH and RALPH M. TOVELL. *A.esthesiology* 1948, 9: 400

Regional anesthesia has been profoundly affected by the introduction of new agents and improved methods of administration of standard drugs. The methods most frequently in the public and professional eye are discussed.

The introduction of balanced anesthesia contributed to a renewal of interest in spinal anesthesia. The development of continuous spinal techniques has made possible a revolution in thinking in regard to agents and methods for this type of anesthesia. Recently the greatest amount of time and thought given to any one technique has been devoted to the valuation of continuous caudal analgesia. Many of the over-all complications originally reported are now avoided by the judicious selection of patients. It is likely that the more frequent use of balanced anesthesia may contribute an increased measure of safety and efficiency to the procedure.

Procaine is still the agent of choice. Repeated comparative studies have demonstrated the relative safety of this drug. As a vasoconstrictor capable of producing a local reaction without untoward systemic effects, cocaine has proved its value. The concentration of procaine in solution is varied according to the type of block employed. The maximal safe dose is considered to be 1.0 gm. of the drug.

It is evident that regional methods still have an important place in the practice of anesthesiology. Frequently they are combined with other methods to meet the needs of patient, surgeon and anesthetist.

MARY FRANCES FOX, M.D.

Psyche-Sparing Anesthesia (Psychoschonende Narkose). H. SCHLESINGER. *Chirurg* 1948, 9: 45

The author stresses the importance of planning an anesthetic sequence which will not only spare the patient pain during the operation, but also the psychic trauma attending any operative procedure. He first suggests discussion of the anesthetic freely with the patient. If the patient has had an uncomfortable experience with a previous anesthetic, it is wise to change the medium, or at least to reassure him that the discomforts will be avoided this time. The ideal anesthesia would be one which would start as soon as the patient is prepared for the operation, and continue until all of the postoperative dis-

urea has been passed. This is, of course, impossible but it is an ideal status which should be desired in the future.

The most perfect anesthetic from the standpoint of the patient's psychic state, in the author's opinion, is rectal avertin. Unfortunately the use of this medium is attended by too high a mortality and morbidity to make it generally practicable. In the author's series of 10,000 cases there were 4 fatalities which might be attributed to the drug. Therefore at the present time the intravenous use of barbiturates with constant administration through tubing appears to be the best procedure.

WILLIAM C. BECK, M.D.

**Trichlorethylene (Trilene) as an Anesthetic in Neurosurgery** G. J. C. BRITAIN *Current Res. Anesth.*, 1948, 27, 145

During the past 3 years trichlorethylene (trilene) has been used in the E. M. S. Neurosurgical Unit for more than 250 major operations embracing a wide range of cases. The anesthesia technique is described. A minimum of apparatus is used; the trichlorethylene is given as an adjuvant to nitrous oxide and oxygen.

The advantages of the method include the complete absence of toxic effects on the cardiovascular system, liver or kidney; the lack of anoxemia; less capillary bleeding than when nitrous oxide, oxygen or cyclopropane is used alone; and complete elimination of the explosion hazard. There is no struggling, straining or coughing during induction.

The technique involves the spraying of the nose, pharynx, and vocal cords with a 1 per cent nupercaine, followed by an induction with sodium pentothal and direct vision endotracheal intubation. Anesthesia then is maintained with nitrous oxide and oxygen, with a minimum of trichlorethylene. The method

has been used in poor risk cases and in children. Eight illustrative cases are briefly described.

MARY KARP, M.D.

**Oxygen Therapy in Surgery** WENDELL H. KLEWER, *Am. J. Surg.* 1948, 76, 76

This article presents a discussion of the therapeutic value of oxygen in surgery. A brief review of the physiology of respiration is given including the effects of carbon dioxide excess and oxygen lack. The types of anoxia are enumerated and there is presented a brief historical review of the use of oxygen in therapeutics. In any consideration of oxygen therapy in surgery it is well to keep in mind the fact that the drugs most widely used in surgery—morphine, scopolamine and the barbiturates—exert a depressing effect on the respiratory center. Those surgical conditions are considered for which oxygen therapy is especially beneficial. They are head injuries, shock, postoperative ileus, postoperative pulmonary complications, thoracic wounds, pulmonary burns, thyrotoxicosis and anesthesia.

Seven per cent carbon dioxide and 93 per cent oxygen is of greater value than pure oxygen alone because from 5 to 7 per cent carbon dioxide with oxygen increases the cerebral blood flow up to an average of 75 per cent and it also increases pulmonary ventilation.

Adequate blood replacement during surgery and the use of oxygen, especially if an inhalation anesthetic is used, should be resorted to both in the operating room and postoperatively. It must be remembered that cyanosis and dyspnea are not present in the early stage in the development of anoxia. The use of 7 per cent carbon dioxide and 93 per cent oxygen mixture as a preventive and therapeutic aid for anoxia is not as widespread in surgery as it should be.

MARY KARP, M.D.



# PHYSICO-CHEMICAL METHODS IN SURGERY

## ROENTGENOLOGY

Certain Images of Striae in Pulmonary Fields (Sopra alcune immagini strie nei campi polmonari)  
M URO PIZZONTE. *Red. di med. Milano*, 1948 34-193

Among the various striae visible in roentgenograms of pulmonary fields, three are of clinical importance:

1. Fleischner's striae or basal striae of lamellary atelectasis. These have a horizontal direction and are usually from 15 to 16 cm. long and approximately 3 mm. wide. They are usually located in the lower third of the pulmonary field, in proximity to the diaphragmatic vault and less frequently in the middle third. They may be unilateral or bilateral, and are more frequently found on the right side than on the left. As to their pathogenesis, they are caused by a so-called directional collapse which in turn is due to several factors such as retraction of the lungs and resistance of the lungs, pleura and the thoracic wall.

The differential diagnosis must consider two conditions: horizontal striae of pleural origin and parenchymal fibrosis. A rapid disappearance of the striae and their location in the lower portion of the lungs support the diagnosis of Fleischner's striae.

2. Reichmann's striae or "rainy streaks." A coalescence of nodes produced by silicosis may produce shrinkage which leads to the formation of indentations and folds in the lungs. In roentgenograms such formations produce striae extending from areas of shadows to the diaphragm and resembling streaks of rain. Angular elevation of the diaphragm may result. Autopsies in such cases fail to demonstrate pathologic bands and adhesions between the lungs and the diaphragm.

Unlike striae caused by other pulmonary processes, Reichmann's striae do not originate in the hilus but are directed from extensive areas of increased density straight downward.

3. Striae according to the author's studies on cadavers may be of interlobar pleural origin. Such striae have been observed by the author in 50 per cent of infantile lungs. Such striae may be caused by an accessory posterior lobe or by a minute hyperplasia of the epithelial layer accompanying congestion and slight exudative processes. Partial synchysis, partial pneumothorax, slight accumulations of fluid between the lobes, or circumscribed pleurisy may also produce striated images.

ARTHUR F. CINOLLA, M.D.

J. Jejunogastric Intussusception. A Rare Complication of the Operative Stomach. STEN ALLEN. *Acta med. Stockh.*, 1948, 90 383.

Jejunogastric intussusception is apparently a rare complication after stomach operations for on review of the literature the author found only about 70 re-

corded cases since Bozal first described the condition in 1914, and in only 3 of these was partial gastrectomy done, the other cases having occurred after simple anterior or posterior gastroenterostomy with or without enteroenterostomy. Only 12 of the 70 odd cases were diagnosed first roentgenologically apparently because few of the patients were subjected to examination with radiopaque media. The author presents the thirteenth case so diagnosed.

The patient had a partial gastric resection by the Billroth II Polya technique with posterior gastroenterostomy at Sabbatsberg Hospital, Stockholm, in 1937 because of a recurrent duodenal ulcer. He was then symptom-free until 1940 when he became acutely ill several hours after a crayfish dinner during which he took several strong drinks. The attack began with nausea and vomiting; a little later cramping epigastric pain developed at intervals of 5 to 10 minutes relieved by vomiting of food at first, then bile then blood. There was no bowel movement but gas was passed. An abdominal roentgenogram taken on the day of entry showed nothing of note and several days later the cholecystogram was normal. The urine showed an increased diastase content, and this prompted a diagnosis of acute gastroenteritis and pancreatitis. The attack subsided in 3 days.

The patient was then well until June of 1946 when he was readmitted with a precisely similar attack except that it was not preceded by dietary excess nor accompanied by increased urinary diastase. The abdomen was soft, but in the left epigastrium there was active muscular contraction and marked tenderness. An abdominal film again showed no definite pathology, but when barium was given orally a large intragastric filling defect was seen protruding into the stomach from the stomal site and presenting the typical pattern of the folds of Kerkrag outlined by barium. Jejunogastric intussusception was diagnosed and confirmed at operation an hour later when approximately 50 cm. of the efferent loop of the jejunum was found to be invaginated into the stomach and easily reduced. The gastric stump and the afferent loop were widened, but nothing else unusual was noted; the stoma was the width of about 2 fingers. Except for a minor attack of pain in October 1946 the patient was free of distress during the subsequent year.

Since the 1940 attack was practically identical with that in 1946, it is now assumed that the former episode also was due to gastrojejunal intussusception which eventually underwent spontaneous reduction. Prolonged blockage of the duodenal loop during the first attack is thought to have been responsible for the increased urinary diastase level at that time.

In addition to the acute cases such as described, which carry a grave prognosis necessitating prompt operation, the literature records chronic cases characterized by a feeling of fullness in the epigastrium

shortly after meals and frequently associated with mild vomiting and sometimes with cramping epigastric distress. Recovery usually occurs within an hour or two. Such cases may be examined roentgenologically on repeated occasions without the discovery of an abnormality and then more or less by chance a subsequent roentgenogram may reveal an intussusception. Reduction was watched fluoroscopically in one chronic case. At operation the roentgen-demonstrated intussusception may or may not still be present in some cases the phenomenon has been induced during operation.

The intussusception may involve the afferent limb of the anastomotic jejunal loop only the efferent limb only or both (combined type). The size of the stoma has varied widely. Neither at the exploratory laparotomy nor at autopsy has an anatomicopathological lesion been found to account for the production of the phenomenon and the cause is therefore assumed to be functional. Involvement of the efferent loop is commonest in the recorded cases and apt to lead to more severe symptoms than afferent involvement. The simple one-limb type is usually of late onset, the average interval after operation being 6 years. The combined type of intussusception which is essentially a prolapse of the jejunum through the gastric stoma is the type usually found as an immediate postoperative complication. The author has seen such a case through the courtesy of E. Perman. The diagnosis was missed originally in 1924 but the old films are now believed to be diagnostic. This discovery increases to 5 the number of cases of gastrojejunal intussusception reported after partial gastrectomy.

Only 18 of the cases in the literature were examined with radiopaque media. The diagnosis was made as a result of the procedure in 12 instances, and a review of the films shows that it could have been made in 3 more cases. Another case showed only failure of gastric emptying. Early diagnosis is vital in patients with acute gastrojejunal intussusception since operative delay beyond 48 hours is said to increase the mortality to 50 per cent. Unless there is a palpable intussusciptum however the diagnosis is rarely made clinically. Therefore the author urges that contrast media be employed whenever possible in patients who have developed upper gastrointestinal symptoms following gastric operations.

LILLIAN DONALDSON M.D.

**The Case for Functional Cholecystography Comparative Studies on the Aqueous Oral and the Bronner Tests, both Administered to the Same Normal Healthy Subject** (In merito ad una colicografia funzionale. Ricerche comparative fra la prova idrico orale e la prova di Bronner in medesimi soggetti normali) FRANCO HERNANDEZ. *Radiol. med.*, Milano 1948 34 263.

Nothing a disagreement between Casati (*Radiol. med.* 1946 pp 33 and 448) and P. Buisson (*Radiol. med.* 1946, p. 298) as to the relative merits respectively of the aqueous oral and the Bronner tests as

an adjunct to the usual cholecystographic technique using the ordinary intravenous contrast media the author was able to complete comparative studies on 18 normal individuals. The technique consisted in the administration of a glass of water at ordinary room temperature (aqueous oral test) followed 2 or 3 days later by a repetition of the cholecystography with the administration of crude egg yolk (Bronner test) at the moment of injection of the contrast medium with roentgenograms taken at intervals of 0, 5, 10, 15, 20, 30 and 60 minutes thereafter. The phenomena sought to be compared were the increase under stimulus, in the opacity of the shadow of the gall bladder and in the promptness of onset and extent of the induced motor activity of the organ.

On the whole the evidences of increased contraction of the shadow cast by the contrast media were obtained or were absent indifferently with either the aqueous oral or the Bronner tests. No constant relationship could be observed between the shadow increase and any modification (contraction) of the bladder morphology. With regard to the motor activity induced in the organ under these methods of stimulation a moderate amount of contractile stimulation could be observed rather regularly with the aqueous test however this phenomenon could not be compared in intensity and thoroughness with the complete and progressive emptying of the gall bladder under the stimulus of the egg yolk.

From these results the author concludes that at least from the normal dynamic standpoint the Bronner test is of greater practical value in cholecystography.

JOHN W. BREXMAN M.D.

**Roentgenologic Changes in the Urinary Bladder and the Distal Portion of the Ureters in Spermatocystitis.** GUNNAR EDSSON. *Acta radiol.*, Stockh., 1948, 39 371.

In a group of orthocystographic examinations made at the Caroline Hospital in Stockholm on various clinical grounds some of the cystograms showed localized irregular indentations of the mucosal surface of the inferoposterior aspect of the fundus of the urinary bladder. The irregularities were either finely jagged or more coarsely nodular. The appearance suggested an inflammatory process in the region where the seminal vesicles are closely applied to the urinary bladder, and a spermatocystitis was therefore considered the probable explanation. Subsequent investigation including rectal and cystoscopic examinations confirmed this suspicion.

Cystoscopists have called attention to local basal cystitis as a manifestation of infection of the underlying seminal vesicles, but the author in reviewing the literature did not find that this cystographic change was recognized as a diagnostic sign of spermatocystitis or perispermatoctitis. He regards the sign as of some importance because while other associated diseases usually of the prostate or urethra, are often the first to draw attention the spermatocystitis, which may be easily overlooked on clinical grounds, contributes greatly to the patient's distress in many instances.

# PHYSICO-CHEMICAL METHODS IN SURGERY

## ROENTGENOLOGY

Certain Images of Striae to Pulmonary Fields (Sopra alcuni immagini di striae nel campo polmonare)  
MAURO PIERMONTI. *Radial med. Milano*, 1945, 34, 93

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JOHN W. BRENNAN M.D.

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In a group of urethrocytographic examinations made at the Caroline Hospital in Stockholm on various clinical grounds some of the cystograms showed localized irregular indentations of the mucosal surface of the inferoposterior aspect of the fundus of the urinary bladder. The irregularities were either finely jagged or more coarsely nodular. The appearance suggested an inflammatory process in the region where the seminal vesicles are closely applied to the urinary bladder and a spermatocystitis was therefore considered the probable explanation. Subsequent investigation, including rectal and cystoscopic examinations confirmed this suspicion.

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Six cases are presented, 5 of them in some detail. All the patients were adult, their ages ranging from 26 to 4 years. Five of the patients were admitted with one or more of the following complaints: perineal or low unilateral abdominal pain, acute tenesmus and smarting pain on urination and marked urinary urgency and frequency. In each case the cystographic changes were the same as those described and confirmation was obtained either by rectal palpation and cystoscopic examination or by autopsy of the presence of a diffusely enlarged tender seminal vesicle with edema and hyperemia of the mucosa of the overlying urinary bladder. The prostate in these cases was either normal to palpation, or more often moderately enlarged, firm and well circumscribed. In one case the inflammation extended posteriorly to involve the rectum as demonstrated both radiographically and by direct inspection. Four months later the patient was asymptomatic and both the rectal and cystographic inflammatory signs had disappeared. The sixth case was one of acute urinary retention secondary to urethral strictures resulting from gonococcal infection many years earlier and the urethrocytographic demonstration of local change in the posterior portion of the urinary bladder was regarded as of minor importance.

Spermatocystitis may also cause inflammatory changes in the ureter leading to ureterostenosis particularly in those individuals in whom the most distal portion of the ureter is in intimate contact with the seminal vesicle for a distance of a centimeter or more and in whom the process has become chronic.

The author presents 4 cases, one of them from the group mentioned in which hydroureter and hydronephrosis were found in the absence of evidence of calcified stone and in which roentgenograms demonstrated stricture from 1 to 4 cm. long in the most distal portion of the ureter. Rectal examination revealed diffuse tender enlargement and infiltration at the site of the seminal vesicle on the involved side and cystoscopy showed unilateral localized trigonal edema and redness of the mucosa of the urinary bladder on that side especially in the region of the ureteral orifice about the internal urethral sphincter. Probing of the ejaculatory duct in one case caused pain to gush forth. The hydronephrosis was so great in another of these cases that nephrectomy was deemed advisable and at operation the roentgen findings were confirmed and evidence of ureteritis at the site of stricture was established. The presenting complaint in these cases was periodic pain and trailing termination in one instance accompanied by chill on urinating. An old history of gonorrhea was obtained from 2 of the patients.

While Heller and Merriks, among others, have mentioned the ureterostenosing effect of spermatocystitis little consideration has been given to it in radiological literature. The author suggests that if the possibility of this type of stricture is kept in mind in dealing with cases of unexplained dilatation of the renal pelvis and ureter the condition may be found more frequently. LEE DOUGLAS, M.D.

Anomalies of the Spine In Anomalies of Viscera and Constitution. JOURNAL TO CHIRURGIE 10. 1918. Stockholm 048, 20 3

Anomalies of the spine are frequently encountered in association with visceral and constitutional anomalies. In amphibia there is a direct relationship between the notochord and the dorsal lip of the blastophore.

Two cases of sirenomform monsters with a lumbosacral defect, scoliosis of the spine. Imperforate anus and malformation of the urinary tract are described. These cases denote a relationship of the primitive streak and the notochord in visceral development. Seven cases of visceral invagination and anomalies of the spine are described. In many of the latter there are signs of hormone imbalance: gigantism, diabetes, and excess adipose tissue. In such instances the associated anomalies rest between the hypothalamus, thalamus, and anomalies of the spine.

The roentgen findings support the author's contention that in man, as in amphibia, there is a developmental relationship between the notochord and the viscera. MAURICE D. SACHS, M.D.

Roentgendagnostic Points of View of Spinal Tumors in Children. OBER DOUGLAS, LEE DOUGLAS. Stockholm, 1918, 20 79

Spinal tumors in children are infrequent. However the diagnosis of spinal or extradural tumors should be kept in mind in instances of undiagnosed back pain.

Roentgenograms depicting extradural cysts or tumors reveal pedicle erosion, widening of the interpedicular space, rarefaction of the laminae and erosion of the body of the vertebrae. Delay of ossification center closures due to increased intraspinal pressure and kyphoscoliosis in spinal extradural cysts may be present.

Two cases, one of extradural cyst and one of intramedullary osteocytoma, diagnosed by means of roentgenograms plus clinical examinations are reported.

MAURICE D. SACHS, M.D.

Vacuum Intervertebral Discs. E. MC SATELL. Brit J Radiol 048 337

In 3 patients referred for roentgenograms of the lumbosacral spine because of low backache lateral views showed a linear streak of radiolucency in the center of the lumbosacral disc. This was interpreted as a transitory accumulation of gas derived from the blood stream, which had seeped into the center of the disc to fill the vacuum created when the disc back had suffered degeneration and loss of the nucleus pulposus was put under strain. The author accepted the finding of such an accumulation of gas as pathognomonic for disc degeneration but agreed with Magnusson, who first described the phenomenon, that the gas itself does not cause clinical symptoms. Its presence is fleeting for it disappears whenever the strain is taken off the disc by allowing the patient to assume a less lordotic, horizontal, or the erect, position.

The 3 cases of vacuum disc presented in this article occurred in 2 men and 1 woman aged respectively 71, 54 and 66 years. In each case there was narrowing of the lumbosacral space and osteophyte formation on the adjoining vertebral bodies which were regarded as associated signs of disc degeneration. The neurological examination was negative.

LILIAN DONALDSON, M.D.

**The Roentgen Changes Produced by Diffuse Torulosis in the Newborn.** EDWARD B. D. NEUMAYER and ARTHUR TUCKER. *Am. J. Roentg.* 1948 50 203

The authors describe 3 cases of torulosis with roentgenological findings. The condition is a relatively rare subacute or chronic infection caused by the *Torula histolytica* (*Cryptococcus neoformans*), a fungus that is occasionally found on normal skin and in the feces and occasionally appears to inhabit the female genital tract although it has been often thought that these cryptococci were not pathogenic. More than 100 cases of torula meningencephalitis, or diffuse torulosis have been reported but none of the patients have been under the age of 3 years and only 4 have been reported who were under the age of 10 years. Torula may invade the lungs, skin, joints and subcutaneous tissues but most frequently involves the central nervous system. In the 3 patients described the infection probably occurred either during intrauterine life or at the time of delivery. The damage produced by the fungus was severe and was fatal to all 3 infants within a few weeks after birth. Each of the infants showed evidence of mild hydrocephalus and diffuse punctate and confluent calcification of the severely degenerated brain on roentgenographic examination. The calcification resembles that seen in toxoplasmic encephalitis. Enlargement of the liver and spleen was present in each patient. Two patients showed inflammatory and granulomatous lesions in the lungs and 2 showed non-specific submetaphyseal decalcification in the long bones.

FRANK L. HUBERT, M.D.

**Penile Carcinoma. A Review of 43 Cases Treated at Bellevue Hospital During the Past 25 Years.** JOSEPH ZAUSSER. *Radiology* 1948 50 786

Although the number of cases of penile carcinoma reviewed is rather small for statistical purposes, some worthwhile conclusions can be drawn on certain phases of this condition.

A study of its incidence shows that circumcision at an early age seems to offer protection against the development of the disease.

The average age at the onset of symptoms was 42 years, the largest number of cases occurring in patients in the sixth decade.

The most important etiologic factors were phimosis or paraphimosis with insuppurated smegma which occurred in 52 per cent of the cases and syphilis, which occurred in 20 per cent. In 12 cases no laboratory tests were made.

The primary lesion was located on the glans in 12 cases, the coronal sulcus in 7 cases, the shaft in 7

cases and the prepuce in 4. It was unrecorded in 4 cases. Nine of the patients had a previous penilectomy.

Metastases to the inguinal nodes were noted in 70 per cent of the cases at the initial examination. In a similar percentage the involvement was bilateral.

Histopathologically the carcinoma was of the squamous-cell type in 33 cases, the basal-cell type in 1 case and the intraepithelial type in 1 case. In 8 cases the histologic nature was unknown.

The patients were given varied types of treatment. Based on the results obtained and from a study of the literature, the author proposes different procedures for the various clinical stages of penile carcinoma as follows:

1. If the lesion is less than 2 cm. in diameter, medium voltage roentgen therapy with a total tumor dose of from 4,000 to 6,000 roentgens or a radium mold delivering 6,000 roentgens (gamma) is recommended.

2. If ulceration with infiltration is present, the primary lesion is treated with a radium mold and deep roentgen therapy of a total dose of from 1,800 to 2,400 roentgens is administered over each groin.

3. If the corpora cavernosa are involved, penilectomy and bilaterally inguinal node dissection are performed, associated with preoperative and postoperative deep roentgen therapy over the inguinal areas with a dose of from 1,800 to 2,400 roentgens on each occasion.

4. If the inguinal nodes are involved but not fixed, penilectomy, orchiectomy, resection of the scrotum and bilateral inguinal node dissection are done, preceded by deep roentgen therapy or radium pack therapy to the inguinal regions and followed by deep roentgen therapy to the perineum in a dose of from 1,800 to 2,400 roentgens.

5. If the inguinal nodes are fixed and in recurrent cases, radium pack therapy is used.

In trying to tabulate the final results, the author was able to collect the follow-up data of only 10 patients. Of these 7 were alive and free of disease, 5 were alive with disease and 7 were dead. Of the 7 patients who were alive without disease, all had been treated by a combination of surgery and irradiation.

T. LEUCUTIA, M.D.

**Radiation Therapy of Hodgkin's Disease (Zur Strahlenbehandlung des Lymphogranuloms).** WILHELM TESCHENDORF. *Deut. med. Wochschr.* 1948 73 164

There is general agreement that effective roentgen therapy of Hodgkin's disease should cause the disappearance of all palpable glands and gland groups. The experience that gland regions subjected to heavy dosage are not soon reinvolved has led to the scheme of focal destruction. A dosage of from 2,000 to 4,000 roentgens given over a period of from 4 to 5 weeks will accomplish this. Many radiologists believe that one should then wait and employ radiation therapy again when new glandular masses appear. The question arises whether or not it is possible to hinder or eliminate the new development

of glands by properly timed radiation. Since one cannot predict the site of recurrence the question of total body radiation, or at least radiation of the entire trunk, must be considered. The author's method of total body radiation as used in leucemia was unsatisfactory in the management of Hodgkin's disease because of the severe general reaction which followed. His method of combining intensive local therapy with deep regional radiation of parts of the body in effect, total body radiation is described.

After intensive radiation of involved gland regions through local fields has brought about regression of the glandular masses, a short pause is prescribed. Residues often disappear only under further treatment. The body is then divided into four regions—breast, abdomen, upper back down to the diaphragm and lower back—and regional deep therapy of the entire body is begun. A dosage of from 25 to 30 roentgens per sitting from a distance of 100 to 160 cm. has proved adequate. Within a month the four regions are each radiated once either in four sittings in a week followed by a 3 week pause, or what is more comfortable to the patient in weekly treatments of one body region. Treatment is carried out for at least 10 to 12 months and repeated after a 3 to 3 month pause.

This scheme is only theoretically feasible and must be modified to suit the individual patient in accordance with his general condition and particularly with respect to his blood picture. It may also be necessary to interrupt the regional irradiation in order to carry out intensive local treatment of newly appearing gland enlargements.

Protocols of the management of 2 cases are given to illustrate the rhythm of the method.

JONAS L. LINDQVIST M.D.

### RADIUM

The Treatment of Cancer of the Maxillary Antrum by Radium. MARGARET C. TOD. *Brit J Radiol* 9:18 70

Of the 222 patients with cancer of the maxillary antrum treated at the Holt Radium Institute of Manchester England from 1932 to 1941 25 per cent survived 5 years, most of them without evidence of recurrent disease. Those cases in which it was estimated that the whole tumor could be encompassed in a sphere 4 cm. in diameter and in which any recognized bone destruction was limited to not more than two adjacent walls of the cavity, were classed as early. These numbered 95 and the 5 year survival rate was 36 per cent whereas in the 127 "late" cases the survival rate was only 17 per cent.

From 1932 to 1937 the usual method of treatment was rhinotomy with surgical excision of the main tumor mass followed by insertion into the cavity of a ball of sponge rubber containing at its center a radium tube. The usual dose calculated on the surface of the sponge was about 8,000 roentgens delivered in 10 days. The method showed fair success even in some of the advanced cases, but the im-

mediate postoperative mortality was 25 per cent, largely as a result of sepsis or hemorrhage.

Therefore a simpler method was used in a large number of patients treated in the latter half of the 10 year period and was found particularly applicable to common squamous cell carcinomas of the antrum. In the 63 cases so treated the 5 year survival rate, with almost no evidence of recurrence, was approximately the same as for the previous method, while the immediate postoperative risk was much reduced.

This simpler method is as follows: under intratracheal anesthesia and with pharyngeal pack in place a tube containing 25 mgm. of radium in 3 cm. length is introduced, usually through the Caldwell-Luc approach, into the center of the tumor mass and left there until an estimated dose of 8,000 to 10,000 roentgens has been given in 7 to 10 days at points 2 cm. from the central radium source. The radium tube is thinly covered with rubber and the end of this rubber covering protrudes through the hole made for insertion and is fastened there by a rubber covered stay suture placed through the full thickness of the cheek.

Necrosis of any tumor tissue or even any normal tissue within the 2 cm. radius is the calculated result. No severe symptoms follow provided there is good drainage into the mouth through the hole in the antrum made for insertion of the radium. Occasionally if the tumor is large or if sequestering bone should hinder drainage the opening may have to be enlarged to clear out the slough. Pain is then promptly relieved. Penicillin of course, has proved useful in reducing sepsis.

The method is not recommended for tumors of the mixed salivary type or for those of the reticuloendothelial type. The former group is very radio-resistant and therefore best treated by surgical excision. This was usually followed by radium, but little evidence was obtained that the radiation reduced the marked tendency of this type of slow growing tumor to local recurrence. Of 10 patients treated by the combined method 8 were alive 5 years later but all except 3 showed recurrence.

The reticuloendothelial tumors are both sufficiently radiosensitive and infiltrative to make roentgen-ray over large fields extending from orbital ridge to clavicle the method of choice. A dose of 3,000 roentgens in 3 weeks is recommended. Of 18 patients with lymphosarcoma most of whom were treated by roentgen ray 50 per cent were living and apparently well 5 years later.

Biopsy for the ascertainment of cell type is then fore strongly recommended before final decision is taken as to method of treatment for any given antral cancer.

LILIAN DONALDSON M.D.

### MISCELLANEOUS

Effects of Small Daily Doses of Fast Neutrons on Mice. TITUS C. EVANS. *Radiology* 91:3, 50:81.

The irradiation with neutrons in certain respects is more dangerous than the irradiation with roentgens.

rays or radium. The maximum permissible daily exposure for roentgen rays and radium was set for some time at 0.1 roentgen per 8 hour day for a 55 day week. It is now necessary to establish a similar safe tolerance dose for the neutron rays.

With this view in mind the author has carried out a series of experiments on the effect of small daily doses of fast neutrons on mice. The work has been performed for the Manhattan Project and The Atomic Energy Commission.

In the preliminary experiments male and female mice of the Swiss Strain (Rockland Farms) were used. In the main experiments mice of the CF<sub>1</sub> strain (Carworth Farms) were also employed. The animals were from 4 to 6 weeks of age.

The neutron radiation was obtained from the 36-inch cyclotron in the Pupin Laboratories of Columbia University.

The dose was expressed in the arbitrary unit of "N" which represents the ionization produced in the 25 roentgen Victoreen chamber. It should be mentioned that the unit "N" used by other workers is based on ionization in a 100 roentgen Victoreen chamber a fact which may account for considerable difference. The highest neutron intensity used by the author in his experiments was 1 "N" per minute.

The animals were irradiated in cages holding 25 mice each. Two cages were, as a rule placed together in a large semicircular lead box which was at a distance of 28 inches from the source.

The roentgen exposures were carried out with the following factors: 185 kv (peak) 2 mm. of copper and 1 mm. of aluminum as filters 56 cm distance field of 10 cm in diameter and an intensity of 10 r/min. The radiation was measured in air with the

same 25 roentgen Victoreen chamber as was used for measurement of the neutron rays.

The following summary of the results is given by the author.

Daily doses of 0.014 "N" of fast neutrons (0.07 "N"/wk.) equivalent to 0.1 r/day of x rays (on the basis of relative effects of single exposures) had no definite effect on mice treated for approximately 87 weeks.

Some effects (though still not pronounced) were observed in animals exposed daily to 0.07 "N" with a total dose of approximately 30 "N".

Daily exposures of 0.14 "N" (total of 60 "N") definitely reduced the survival time slightly reduced the growth activity of the hemopoietic organs and gonads and slightly increased the frequency of cataracts.

Doses of 1.4 "N" per day resulted in death of more than 50 per cent of the animals by about the 29th week (total "N" = approximately 200). This irradiation caused pronounced changes within a few weeks in the blood counts and the activity of the hemopoietic organs and gonads. In addition extreme damage to the lens was evident by the time half of the original number of animals had died.

Daily exposures of 1.4 "N" were more effective than those of 11 roentgens (equivalents on the basis of relative effects of single exposures). Some effects based on the total dose at the time of appearance indicated a ratio of 12-13 roentgens to 1 "N". The effects of 1.4 "N" per day on the gonads and lens were more pronounced than even the ratio of 12 roentgens to 1 "N" would indicate.

Considering the results generally the most important finding was that the lens was especially sensitive to the neutron radiation. T LUCOTTA M D



## MISCELLANEOUS

### CLINICAL ENTITIES—GENERAL PHYSIOLOGICAL CONDITIONS

**Streptomycin Dermatitis in Nurses.** JOHN CROSTON and H. M. FOREMAN *Br. M. J.* 918, 7

Four nurses, of approximately 80 handling streptomycin at the Brompton Hospital, London, during a period of 8 months developed dermatitis. Their exposure varied from 6 weeks to 6 months.

The dermatitis consisted of an itchy, papular erythema of the skin around the eyes and over the elbow flures. In only one nurse were the hands involved.

Skin-sensitivity tests with 50 mgm. of streptomycin in 0.1 ml. of saline solution were positive in the 4 affected nurses but negative in controls.

People handling streptomycin should wear rubber gloves and avoid soiling their skin with the material.

JOHN J. MALONEY M.D.

**Metabolic Study of Burn Cases.** J. W. KLYZER I S 5 945, 605

This work had as its principal object a complete study of the nitrogen balance of burned patients including the loss of protein in the exudation from the burned area. The report is divided into sections.

Urine was collected in bottles and chloroform, 0.5 per cent solution of this in chloroform was used as a preservative.

The total nitrogen in the urine was determined by the Kjeldahl method. The feces were usually not tested, the fecal nitrogen generally being taken one-ninth of that in the urine.

The exudat was collected in cellucotton or wool, the dressings being covered with washed, tanned cellophane placed immediately under the crepe pressure bandages to minimize leakage. The nitrogen in the dressings was determined by boiling them with 10 per cent sulfuric acid and taking a sample of mixture for Kjeldahl digestion. A blank value for dressings and reagents was obtained by treating in the same way an approximately equal quantity of the materials employed. The results were further corrected for the nitrogen in the penicillin-sulfathiazole cream used, it being assumed, for purposes of calculation that little or none of the sulfathiazole had been absorbed.

A fraction, usually one fifth of the food was kept aside and at the end of the balance period was ground to a uniform paste. A portion of this, e.g. from 50 to 100 gm., was heated on a water bath with a little sulfuric acid for several hours and samples of the resulting solution or fine suspension were taken for Kjeldahl analysis.

Vomit was homogenized in the same way as food and a portion taken for analysis.

Plasma protein was estimated by the microdigestion and nesslerization method of King.

Urinary creatinine and creatine were determined by Folin's method.

Plasma chloride was determined on 0.5 or 0.1 ml. by digestion with silver nitrate in nitric acid and back titration with alcoholic potassium thiocyanate after the addition of alcohol. Blood was collected under liquid paraffin and the plasma separated as soon as possible.

Urine chloride was determined by the Volhard method.

Blood sugar was estimated by the method of Folin and Wu adapted for 0.1 ml.

Calculation of the areas burned was done by the surgeon and was based on Berlow's values.

### RESULTS

Urinary nitrogen excretion. The urinary nitrogen excretion was measured in 30 cases, in 7 of which nitrogen balances were carried out. The cases are arranged in four arbitrary groups, as in the Glasgow Burns Unit report (L. Colebrook *et al.* 1944) viz—

Group 1 1-5 per cent of body surface burned.

Group 2 6-15 per cent of body surface burned.

Group 3 16-30 per cent of body surface burned.

Group 4 over 30 per cent of body surface burned.

It will be seen that few of the urinary nitrogen figures in Groups 1 and 2 are excessive and that some are in fact low. The highest nitrogen output observed was in a man of 23 years with 20 per cent burns who excreted 40 gm. of nitrogen in a 24-hour collection of urine beginning 3 days after the burning. This high loss of nitrogen in the urine was not maintained, however, and his average daily excretion over a number of days, although above the normal amount, was not as high as might be expected. A boy of 17 years with 60 per cent burns excreted small amounts of nitrogen in the urine during the 4-5 days he lived. Some kidney damage was found at autopsy and this was confirmed by histological examination. This patient received methionine by mouth 2 days after admission but it is impossible to say what effect it had.

Nitrogen balances. Sixteen nitrogen balances were carried out in 7 cases of burns covering from 6 to 50 per cent of the body surface. Detailed case notes are given and these are followed by a discussion of the findings. Unfortunately it was impracticable to weigh any of the patients as the necessary apparatus was unobtainable at the time.

A distinction is made between the nitrogen taken in the food and that of intravenous plasma, and, where possible, between urine nitrogen and excrete nitrogen. In the experience of Major J. A. F. Stevenson, plasma given intravenously does not immediately increase the urine nitrogen; it appears to be simply added to the pool of body protein. This means that in nitrogen balance experiments in burns there are two things to consider—

a. The total nitrogen balance over a period including any plasma protein lost in the exudate and protein given intravenously

b. The metabolic state of the patient on a particular day or over a period of time (metabolic nitrogen balance) in calculating which intravenous plasma and protein lost in the exudate should probably not be included.

It appears that negative nitrogen balances in these cases were due to low intake rather than to a high output of nitrogen, and that when it was possible to induce the patients to eat well it was not very difficult to get them into nitrogen equilibrium. Taylor *et al* and Co Tui *et al* have shown that there is a marked tendency for burned patients to get into negative nitrogen balance, and Co Tui has drawn attention to five possible sources of nitrogen loss: (1) intratissue loss into the burned areas, (2) loss in the exudate, (3) hemoglobinuria, (4) reduction in caloric and nitrogen intake as a result of anorexia, and (5) the possible loss due to an antianabolic period, probably a result of altered hormonal balance. While it must be admitted that the loss in the exudate can be very large, we would draw attention to the fact that this loss, as well as the intratissue loss referred to in (1), is largely compensated (so far as total nitrogen balance is concerned) by the plasma transfusions. Proteinuria was encountered in most, and hemoglobinuria in some of the severely burned patients, but the total amount of protein lost in this way was not large. With regard to the fifth source of loss, the urinary nitrogen was usually found to be not markedly above the normal and in fact some of these patients, especially women, excreted subnormal amounts of nitrogen in the urine. These findings are in agreement with the statement of Cope *et al* that extensive deep burns are not necessarily accompanied by a large loss of nitrogen in the urine. Cope *et al* attributed negative nitrogen balances in their cases to low caloric and nitrogen intakes and the low excretion of nitrogen to the relative absence of infection. Most of the author's cases were relatively free from infection.

It seems likely that the nutritional state of the patient is at least as important as the extent of the injury in determining the level of nitrogen excretion and it is possible that this may explain to some extent, why the author has not been able to confirm in all cases the large increases in urinary nitrogen output found by some of the American workers.

Note on food. Eggs and milk were used extensively and together contributed the greater part of the nitrogen and caloric intake of most of the balance cases. It is doubtful whether hydrolysates are indicated except when digestion or absorption is impaired or when it is impossible to ingest sufficient protein in a more palatable form.

Supplements of glucose were given.

It may be that protein and essential amino acids considerably in excess of the amounts adequate for the maintenance of nitrogen balance are required for healing but we have no exact data bearing on this.

The nitrogen in the exudate was measured in 7 other cases in which complete balances were not carried out.

Pressure dressings to minimize the loss of exudate from the burned area were used by Cope and Rhinlander and by Koch, in America, and were investigated experimentally by Cameron *et al*. Sir J. McK. Duncan of the Unit has used pressure dressings in an attempt to control exudation but there are no data demonstrating their effectiveness.

A quantity of blister fluid from a female with blister burns of the right hand and forearm was analyzed and the results were as follows:

Total nitrogen	0.56 gm. per 100 ml
Total protein	3.4 gm. per 100 ml
Albumin/globulin	1:6
Chloride (NaCl)	490 mgm. per 100 ml

It should be noted that as the clot of fibrin had already separated, the figure for total protein will be slightly low and that for the albumin/globulin ratio slightly high.

In the second case, that of a male aged 54 years, blister fluid (after separation of the fibrin) was found to contain 5.1 gm of protein per 100 ml, the albumin/globulin ratio being 3:3. The plasma protein in this case was 6.7 gm per 100 ml and the plasma albumin/globulin ratio 1:0.9.

#### PLASMA PROTEINS

In 2 of the balance cases serial plasma protein determinations were made over several days. A less steep fall in the plasma proteins was found in one case than of a man of 58 years with burns involving the face, right arm and shoulder and left forearm and hands, he was not given a transfusion. It is possible that the steep fall in plasma protein was partly due to dilution with the transfused reconstituted plasma, which contained only 5 gm. of protein per 100 ml. In other burn cases low values were found.

#### CREATININE AND CREATINE EXCRETION

The urinary excretion of creatinine and creatine as compared with total nitrogen is shown graphically. The high output of nitrogen on the third and fourth day in a man with a 20 per cent burn was associated with a high output of creatinine (2.75 gm) and creatine (1.55 gm). Creatine was found in the urine of 3 other adult males with 15 per cent and 7 per cent burns respectively, but it was absent or present only in small amounts in the urine of 4 other adult males with burns of not more than 3½ per cent. In some cases of creatinuria, in females as well as in males, there appeared to be a peak from the second to the fourth day, but this may have been fortuitous.

Creatinuria has been reported as occurring in normal healthy males but other workers in extended studies have failed to confirm this. In certain of the author's cases it would seem likely that the creatinuria was to some extent a result of the injury and associated pyrexia.

It has been shown that the ingestion of readily assimilable carbohydrate is associated with creatin



therapy as an adjunct pressure dressings being used for immobilization.

The diagnosis is usually simple, but occasional cases with perianal fistulas of dermoid origin must be differentiated from true anal fistulas. The finding of hair in a fistulous tract is evidence of the dermoid origin of the disease. A sign to which the author attaches great significance is one of anal palpation in true anal fistulas one feels a fibrous tunnel or indurated cord from the border of the anus into the rectum. In fistulas of dermoid origin situated near the anus, digital palpation does not reveal the fibrous tunnel in the anus as the latter has normal tissue elasticity but reveals the swelling of the fistula outside of the anus. Anoscopy injection of hydrogen peroxide or dyes into the tract and probing of the fistula also aid when the differential diagnosis is difficult. However the author describes 2 cases of concomitant true anal fistula and perianal fistula of dermoid-cyst origin.

The author describes a closed method of treatment of these cysts, using a plastic technique based on a geometric scheme. This method is applicable to the simple cysts and to the very complex ones with multiple fistulas as well. All the incisions are first traced out. These include a rhombus encircling the fistula, a superior and an inferior triangle for relaxation purposes and débridement incisions when necessary in the more complicated cases. The rhombus is traced out to include the cyst and fistula (Fig. 1). The superior triangle always with a height of 6 cm. is erected 1.2 cm. from the superior end of the rhombus, or lozenge-shaped figure, with a base measuring one-third of the longitude of the rhombus. It is directed laterally and superiorly and extends to the gluteus muscle. The inferior triangle is constructed in a similar fashion on the opposite side from the superior. It is directed laterally and inferiorly and extends to the depth of the fat of the ischioanal fossa. The outlined tissues are resected and the incisions are then closed with cotton sutures to leave a short central linear scar and two oblique lateral ones. In the complicated cases the triangles are drawn to fit the particular situation and closure is likewise effected either totally or partially. A large pressure dressing is used, held on by adhesive tape. Many of the patients are sent home immediately after the operation while others are kept in the hospital. The latter usually receive penicillin. Firm healing is usually complete in from 4 to 6 weeks.

The technique employed in several complicated cases with multiple fistulas is shown by several illustrations.

JAMES E. THOMPSON M.D.

Occult Bone Metastases. RALPH SHACKMAN and C. V. HARRISON. *Brit J Surg* 1948, 35, 385

This study demonstrates how extensive bony metastases may be without there being any demonstrable radiological abnormality. Careful examination of the skeleton at postmortem has shown that metastatic tumor tissue may fill the marrow spaces and yet leave the bony architecture unaltered. The authors

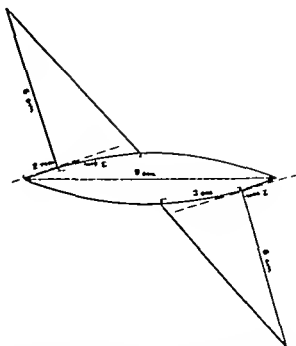


Fig. 1 (Calzaretto) Superior triangulation: the base of the triangle is equal to one-third of the longitude of the rhombus (in this case 3 cm. and the height, 6 cm.). The inferior triangulation is constructed in accordance with the same rules.

took specimens of bone at autopsies on patients dead of malignant disease and selected those specimens which showed deposits discernible to the naked eye without apparent bony change.

Direct contact roentgenographs were made from these excised bones and macroscopically visible and radiologically invisible metastases were demonstrated in more than half of the cases examined. Color photographs are presented side by side with contact roentgenographs of the same bony parts showing the grossly visible metastases in the former and the absence of evidence of metastases in the latter. It is concluded that so-called normal roentgenographs cannot exclude the presence of even extensive bony metastases.

JOHN L. LINDQUIST M.D.

Special Methods for the Diagnosis of Tumors in the Laboratory. N. CHANDLER FOOT. *Am J M Sc* 1948, 215, 479

In spite of the development of newer methods for the laboratory diagnosis of tumors we are still quite dependent on the gross and microscopic examination of tumors. Papanicolaou has given great impetus to the diagnosis of tumors by smears. The success of this method is largely dependent on the cytological skill of the pathologist. The method has been used with success on vaginal fluids, fluids obtained by intruterine aspiration, menstrual fluids, urine (for carcinoma of the bladder), sputum, and bronchial washings. Alimentary tract smears are not very successful because of the distortion of cells by digestion and because of the presence of many foreign cells from ingested meat and the like.

Aspiration biopsies fall into two classes: aspirated serous fluids and solid matter aspirated through a needle or cannula attached to a syringe. The author reports 85 per cent accuracy in diagnosis of aspirated fluids in his laboratory. The chief difficulty with this method is the confusion engendered by the presence of mesothelial cells which interestingly continue to divide if serous effusions much as in tissue culture. The "needle biopsy" has been used quite generally for a long time, but there are serious disadvantages to this method. It does not give one sufficient evidence as to the topography of a given tumor and it may only produce an excellent smear of blood even though a tumor is present—particularly if the growth is fibrous. Much of the success of the ordinary tissue biopsy depends on the surgeon. He must be very careful in what he selects for examination. Frozen sections are very difficult to manage on tiny or feathery growths. Uterine curettings, unless very bulky, are also very difficult to manage by the use of this technique.

The author describes a case in which he was even led to make a frozen section of a bony tumor. Special stain, tissue culture and examination of the blood and urine for certain chemicals are other modern supplements to tumor diagnosis.

JAMES REAVER, M.D.

#### Pigmented Precancerous and Cancerous Changes in the Skin. V. K. K. OLAK, *Acta Res.* 947, 1949.

The author reports the cases of 15 patients with pigmented Bowen's disease, squamous-cell carcinoma and basal-cell carcinoma of the skin seen at the Tata Memorial Hospital, Bombay, India, during the past 5 years. The importance of differentiating these tumors from the melanoma group is stressed.

Eleven patients presented single pigmented basal-cell carcinomas, most of them starting in pigmented moles and characterized by an insidious onset and slow clinical course. There was no deep infiltration or metastasis. All of the lesions were eradicated by excision or contact radiation therapy. Two patients with multiple pigmented basal-cell carcinomas were studied. Their lesions showed a clinical resemblance to pigmented nevi with no accompanying change in the dermis; they grew slowly and did not metastasize, probably originating in pigmented moles, an exhibited variation in form, color and histological detail in the same person. Two more patients were presented who developed bowenoid changes in the epidermis antecedent to a squamous-cell proliferation and the formation of typical squamous-cell carcinoma. In these 3 patients the lesion started as black patches and the growing peripheral areas were deeply pig-

mented as the result of proliferation of dendritic melanoblasts while the overgrowth of neoplastic epithelial cells caused the central portion to become colorless.

The pigment in these tumors gave the usual chemical reactions of melanin, was unevenly distributed in the lobes of the tumor tissue and was more densely deposited in the peripheral cords. It occurred as dust in the cytoplasm of the cells in the stratum germinatum and some tumor cells, as diffuse coloring in degenerating melanoblasts, as coarse grains in the dermis as clumps in the melanophores and as amorphous masses in cystic spaces of the tumor. There was proliferation of dendritic cells in advance of the epithelial cells in these tumors. Part of the dark color of these tumors could be attributed to the lack of normal elimination of dead epithelial cells.

In one of the single basal-cell tumors there was a tendency toward healing in the central portion, and in one of the cases with bowenoid changes several of the lesions were healing in the center. Therefore it is suggested that bowenoid changes should be interpreted as carcinoma with reservations. The possible modes of evolution and spread of these tumors are discussed.

ROBERT MATO TERRY, M.D.

#### DUCTLESS GLANDS

Effect of Folliculin on the Development of Embryonal Implants (Indagine della folliculina sullo sviluppo degli embrioni embrionali). PISCO, LUIGI. *Annali di Medicina*, 1947, 33, 304.

Experiments on implants of fetal tissue were performed on albino rats belonging to a species in which the effect of folliculin on transplantable mammary fibroadenoma had been studied. Embryos 15 mm long were removed from the uterus through a low midline incision and the triturated tissue was injected with a tuberculin syringe into the right breast. The animals were given injections of 500 international units of crystalline folliculin in aqueous solution daily starting the day following implantation of the fetal tissue and continuing until the death of the animal. The experiments were performed on pregnant and nonpregnant rats. The animals were sacrificed from 231 to 317 days after the implantation.

The author concludes from his experiments that large doses of follicular hormone administered over a long period of time favor the nidation and progressive development of implanted embryonal tissue. For a certain period of time the tissues grew but later regression of the major portion of the embryoma was noticed. Pregnancy exhibited an inhibiting effect on the nidation and the progressive growth of the tissues.

ARTHUR F. CIOCELLI, M.D.

# SURGERY

## GYNECOLOGY AND OBSTETRICS

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### VAGINAL AND OVARIAN METASTASES FROM HYPERNEPHROMA

#### Report of Case and Review of Literature

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Portland Oregon

**S**O-CALLED hypernephroma of the kidney is no rarity and in itself would warrant no special comment. The following case of left renal hypernephroma however is reported because of several unusual aspects viz. (1) the first clinical symptom was vaginal bleeding from vaginal metastases (2) left ovarian metastasis occurred without demonstrable evidence of defeminization or virilization and (3) the patient lived  $2\frac{1}{2}$  years after the onset of her original symptoms and represents the 23rd reported instance of this unusual complication (Fig. 1).

No attempt will be made to discuss the debatable question of the histogenesis of the tumors which are generally included under the term hypernephroma. The tumor in our case described in more detail later has been so designated because its component cells were large clear pale well delineated structures which generally characterize this group of renal tumors.

#### CASE REPORT

Mrs. H. S. white aged 57 years primipara, was first seen December 3, 1945 and died December 12, 1947. Her family and personal history were irrelevant. Menstruation ceased in 1937 or 1938. No vaginal bleeding or unusual discharge occurred until

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the onset of the present illness July 15, 1945 when there occurred a spontaneous bright red vaginal discharge. No other symptoms were noted and the patient felt otherwise well. Diagnostic curettage was done on July 16, 1945. The result of the histologic study is not known. Panhysterectomy was performed August 17, 1945; the tubes and ovaries were reported to have been left *in situ*. At this time a small black growth present in the vagina was removed but no histologic study was recorded. A growth of similar appearance and in a similar location was again noticed and removed on October 15, 1945. The pathologist was reported to have been unable to make a definite diagnosis but he did not consider the microscopic picture indicative of cancer. During the entire interval the patient's vaginal bleeding continued in varying amount with episodes so severe that obvious anemia and weakness ensued. When first seen by one of us (K. H. M.) in December 1945 because of vaginal hemorrhage no noteworthy weight loss had occurred.

Physical examination was made December 3, 1945. In the vagina was found a marked accumulation of secretion and a hyperemia due to the presence of a large vaginal pack placed there several days previously by patient's former physician. Vaginal tenderness was so marked that observation was unsatisfactory. It could be seen however that the cervix uteri was absent. Three small discrete red nodules 2 to 5 millimeters in diameter could be fairly distinctly recognized in the left half of the vagina. One of these bled freely. Bimanual abdominovaginal and rectal examinations revealed the firm character of the previously noted nodules and confirmed the absence of the entire uterus.

At examination one week later the vaginal inflammation had markedly lessened and the previously

noted nodules were all bleeding. Careful visualization of the vagina was again difficult.

On December 26, 1945 following hospitalization, complete physical examination was unimportant except for palpation of a large, normally movable left kidney. The urine on this and repeated examinations showed blood. However, only one of the specimens was obtained by catheter.

On December 27, 1945 at speculum examination done under gas anesthesia, absence of the cervix was verified and four nodules were identified (Fig. 2, viz. (1) profusely bleeding one about 1 centimeter in diameter on the left posterior-posterolateral wall about 3 centimeters within the introitus; (2) smaller nodule on the right anterolateral wall near the introitus; (3) one on the right lateral wall midway between introitus and vault; (4) one on the left lateral wall near the introitus. All but one of these were excised with the endotherm unit for biopsy and the bases of all were coagulated. Recovery was uneventful. Intravenous pyelographic study now revealed not only left renal enlargement but moderate hydronephrosis, medial displacement of the ureter and distention of the inferior calyces sufficiently characteristic to warrant the diagnosis of a inferior pole renal tumor. Patient returned home to await the result of the microscopic examination of the paraffin sections and the decision as to the best method of treatment of the left kidney disease. Histologic study of the vaginal nodules revealed a bizarre picture for a growth located in the vagina, namely, the structure of so-called hypernephroma (Figs. 3 and 4).

The clinical impression was malignant nephroma of the inferior pole of the left kidney with vaginal metastases which were the source of serious vaginal hemorrhage.

The patient was seen again January 25, 1946. All previously described vaginal areas were healed and left intact except for the left posterolateral area (Fig. 2, area 1) near the introitus which felt indurated. In addition there was a previously unobserved small nodule (Fig. 2, area 5) possibly 1 centimeter in diameter in the left anterior vaginal fornix. This was dark blue in color, smooth surfaced, firm in consistency and movable. Previous observations were confirmed. X-ray study revealed no recognizable evidence of metastases in the thoracic cavity, thoracic cage, shoulder girdle, dorsolumbar spine, or ilium. The dubious outlook was discussed with the patient's family who felt that nephrectomy should be recommended to the patient.

X-ray studies on February 21, 1946 again showed no metastases. An anterior strapentrotomy epiphrectomy through a long left semilunar line incision was done on February 22, 1946. The left kidney with its tumor (hypernephroma) together with tumor tissue surrounding the ureter near the hilus and a segment of adjacent oviduct (verified histologically) posterior peritoneum was removed without event despite the adherence and marked vascularity of the tissues about the tumor. The entire exposure particularly the access to the renal pedicle under direct

vision and without undue mobilization proved eventually ideal with this approach. Recovery was uneventful, the patient was ambulant on the fourth postoperative day and on February 29, 1946 the nodule in the left anterolateral vaginal fornix was removed. This growth was histologically similar to the others. The operative wound was electrocauterized and the area on the left posterolateral wall again coagulated. Recovery was uneventful.

Abdominal examination April 24, 1946 revealed no pertinent data. Speculum examination showed a small, flat red area in the left fornix and a purplish red tumefaction possibly 1 centimeter in diameter on the left posterolateral aspect of the introitus (Fig. 2, area 6). This bled readily following slight trauma and was excised (May 7, 1946) with a wide margin of normal tissue. The base of this wound and the area in the left fornix were coagulated. The excised tumor was histologically similar to the others. Recovery was uneventful.

July 10, 1946 a mass was palpated in the left pelvis. Patient felt well and was doing her housework at this time. Previous abdominopelvic examination had been done January 23, 1946. The mass was firmly elastic, smooth, and rather freely movable with the vaginal vault. This observation was confirmed on September 12, 1946 although the mass had enlarged somewhat, now measuring possibly 8 to 10 centimeters in diameter. Examinations otherwise negative as were x-ray studies for metastases on September 21. The mass was considered ovarian in origin. The possibility that it might represent a manifestation of tumor metastasis as regarded as an obvious possibility. Laparotomy was done on October 1, 1946. The condition of the right tube and ovary was normal. The uterus as absent and the peritoneal surfaces, except for a few adhesions, appeared normal. A left-sided retroperitoneal mass attached to the left infundibulopelvic ligament and occupying the customary position of a retroperitoneal ovarian tumor was removed (though difficult). Histologically this mass proved to be similar in structure to the original renal neoplasm. Bleeding from veins on the posterolateral pelvic wall was a serious complicating factor causing profound shock. Bleeding was completely controlled and closure was done without drainage. Palpation and inspection in the general region of the previously removed left kidney disclosed nothing pertinent but of further exploration was done because of the blood loss. Patient left hospital on the 22nd postoperative day and was again subjectively well.

December 16, 1946 a nodule (Fig. 2, area 7) 4 millimeters in diameter was noted on right anterior vaginal wall, in the introitus 1 centimeter from the external urethral meatus. This had a pink base and purplish apex (Fig. 1). It was smooth, firm, fixed to the mucous membrane but movable over the underlying structures and was excised with an endotherm unit January 28, 1947. The specimen measured 1.1 by 0.8 by 0.1 centimeter. The patient has last seen in April 1947 showed possible evidence of recurrence.

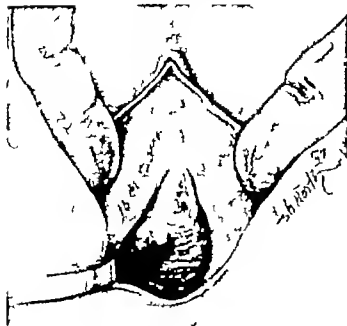


Fig. 7. Metastatic hypernephroma nodule on right vestibulum vaginae. This was last vaginal nodule observed and excised. Figure 2 spot 7 represents this tumor.

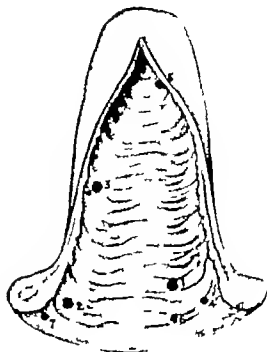


Fig. 2. Diagrammatic representation of location of vaginal hypernephroma metastases. Nodules 1 to 4 were observed December 27, 1945; nodule 5, January 25, 1946; nodule 6, (possibly remanifestation of nodule 2) April 24, 1946; nodule 7, December 16, 1946.

She felt weak and appeared ill but without definite weight loss. Palpation revealed a definite sense of fullness in the left flank. The blood sedimentation rate was 49 millimeters in 45 minutes in May 1946 and continued moderately but definitely accelerated. She subsequently developed a hemiplegia and a definitely palpable mass was noted in the left flank. She died December 12, 1947, 29 months from the time of the first symptom—vaginal bleeding.

*Gross examination of the specimen.* The metastatic vaginal nodules for purposes of brevity will not be described in detail. Their cut surfaces were firm and showed gray and white striations. Some areas showed rather large blood containing channels.

The left kidney (Fig. 9) in its fixed state measured 15 by 8.5 by 7 centimeters. The surface was rough and its inferior half was occupied by a somewhat nodular enlargement which appeared everywhere encapsulated except at a point on its medial aspect where the capsule was broken. On section the pelvis showed obvious though moderate hydronephrosis and in its inferior portion distortion by the tumor. The sectioned tumor surface appeared gelatinous with areas of softening and hemorrhage and was generally of a light yellowish color with areas of deeper yellow and elsewhere areas that were light brown.

The renal vein on careful dissection showed no demonstrable tumor invasion. The left pelvic tumor was a round, well encapsulated mass which in its fixed state measured 6.3 centimeters in diameter. In

cross section there was a central zone of softened liquefying pink material. The more solid, though spongy peripheral portions showed a yellowish coloration with radiating red and pink striations. There was a capsule about 2 millimeters thick. The fallopian tube could not be definitely recognized in the gross though its presence was verified histologically.

*Histology.* The histology of all the tumor tissue was similar to that of the renal tumor which has been described. This was composed of large compact alveoli filled with large polyhedral cells with distinct cell outlines. The cytoplasm was abundant, generally clear but often contained some fine pink staining particles. The nuclei were generally round and varied moderately but definitely in size and staining reaction. The chromatin was moderately to coarsely granular, stained deeply and lay in a comparatively pale blue to clear nuclear matrix. Nucleoli were almost uniformly present. Mitoses were infrequent. The fibrous matrix comprising the supporting structure of the tumor was composed of fine strands of connective tissue varying from one to several cells in thickness. Blood vessels per se were practically absent.

There was a general tendency for central degeneration to occur in these cell masses so that some had the appearance of glandular alveoli. Many of these contained central areas of hemorrhage. Some were lined with a single layer of tumor cells without evidence of degenerative change. Here the alveolar space was occupied by normal appearing red blood





Fig. 3. Vaginal mucosa and underlying tumor. This represents spots 3 or 4 in Figure. Specimens are not separately labeled (time of removal).

cells and had the appearance of a vascular channel. Viable tumor tissue was generally visible only at the periphery of the neoplasm; elsewhere there was necrosis.

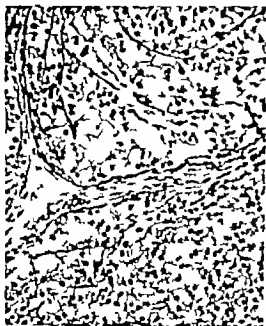


Fig. 4. High power from tumor area in Figure 3.



Fig. 5. Vaginal nodule showing tumor emboli in blood vessels.

crusts. In fact necrosis was so general that blocks for good sections were difficult to obtain.

The vaginal metastases differed from the foregoing only in that overlying stratified vaginal epithelium was generally present. In some sections this was intact. In others there was overlying ulceration where the neoplasm had reached the surface. Tumor emboli could not generally be identified. However, an occasional blood vessel (vein) was seen showing unmistakable tumor embolus (Figs. 5 and 6). Vascular spaces lined with a single layer of tumor cells, as previously described, were common and undoubtedly account for the profuse hemorrhage that occurred when the tumor ulcerated through the vaginal mucosa. They might also be the source of tumor cell emboli and might explain metastatic phenomena when invasion of renal vein was not demonstrable.

Sections of the left pelvic tumor differed only from the foregoing in that ovarian stroma with a corpus albicans (Fig. 7) and the fallopian tube showing tumor infiltration of its external muscularis are recognizable at the periphery of the tumor.

Autopsy findings which are given in barest outline revealed a left retroperitoneal tumor occupying site of previously removed left kidney and extending from lower pole of the spleen into left pelvis at apex of the vaginal vault. The vaginal mucosa is smooth and shows no tumor. The left adrenal gland lies in close apposition to the tumor mass but shows no neoplastic involvement. The inferior vena cava shows a tumor which extends superiorly for 3 centimeters from site of the left renal vein.

Metastases are found in the right kidney cortex, spleen, lungs, brain and myocardium of the left posterior ventricle.

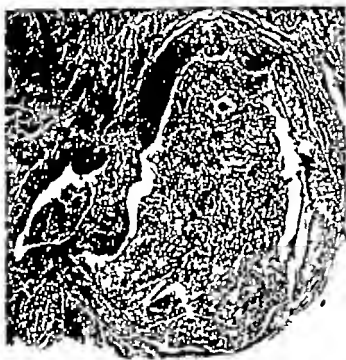


Fig. 6 High power of blood vessels with tumor emboli in Figure 5

#### DISCUSSION

The occurrence of hypernephromatoid structures in the vagina either as fetal rests or as metastatic phenomena from a malignant tumor of similar character is rare. Deming in a study of 29 patients with metastases from renal tumors reports no metastases to ovaries or vagina. Eleven of the tumors were hypernephromas and 5 were adenocarcinomas. In a review of 46 ectopic adrenal rests (not metastases) Lasher describes none occurring in the vagina. Likewise Nalle in a study of 58 renal neoplasms and their metastases encountered no vaginal or ovarian metastases.

Wynne states that about 20 instances of vaginal metastases from nephromas have been reported. Novak considers them extremely rare. Wharton describes two instances of vaginal metastases from renal tumor. In one of these the vaginal tumor which occurred in the vestibule was the first direct proof of the existence of renal tumor thereby simulating Gragert's case.

It is understandable that when metastases become widespread as in the 4 cases reported by Sbaroff and Sala vaginal metastases as late antemortem phenomena are probably not rare. No doubt they would be recognized more frequently if sought at autopsy.



Fig. 7 From left ovary. Corpus alligans at A. Histology of tumor similar to that shown in Figures 3 and 8.

Most writers attribute to Henke the first reported case of vaginal metastases from a



Fig. 8 High power of tumor area in Figure 9.

hypernephroma. Sharnoff and Sala state that Henke's patient was 69 years old that autopsy showed hypernephroma of the left kidney and that in both the renal and vaginal tumors the histologic picture was identical. As a matter of fact, Henke's report is a fragmentary 11 line statement without illustrations and without detailed histologic description. It does not state which kidney was involved in the hypernephroma and it gives the patient's age as 60 years.

In all likelihood the case reported by Hoffmann is the same as the one reported by Henke although all writers have considered each of these as being separate. Henke's report as previously noted is brief fragmentary and gives no details. Hoffmann's report is complete and states that Henke examined the tissue from his case and reported his observations. Additionally in each instance the patient was 60 years of age and had a metastatic skin tumor which showed hypernephroma cells on biopsy. Hoffmann specifically states that this tumor was located in the right thigh and the renal tumor demonstrated at autopsy in the left kidney. There is little danger of error therefore in considering these two reports as concerning the same patient.

The case reported by Overy is also generally accepted by writers on this subject. Overy's case is reported in a discussion of a paper by Doran. He describes an instance of his own in which a patient with a right sided abdominal mass developed a polypoid tumor on the anterior vaginal wall. This tumor was removed, recurred and was again removed. No histologic studies were made of these tumor-factions. The patient died 1 month later and a hypernephroma was found at autopsy. Overy does not state on which side the tumor was located. It is difficult in the absence of histological verification to see how this case can be considered as an instance of vaginal metastasis from a hypernephroma.

Reference to Table I reveals that including our patient 23 instances of hypernephromatous vaginal metastases have been reported. As in our patient the overwhelming majority (18) have occurred in the presence of left renal tumors. This combination has raised some questions, namely are left sided tumors more

frequent than right sided ones? If left sided tumors show a predilection for vaginal metastases, what is the explanation? To answer the first question it may be said that malignant renal tumors in adults occur probably more frequently on the right side. Lubarsch states that 321 of Kuesters 607 collected cases of malignant renal tumors occurred on the right and 272 on the left while of 169 similar tumors collected by Albarran and Imbert 90 occurred on the right and 74 on the left side. Denning reports that among 82 malignant renal tumors studied 53 occurred on the right side. In this same study he found that men were afflicted about 2.5 times more frequently than women.

When malignant renal tumors are segregated according to histologic types all of Lubarsch's compilations for hypernephromas show that men are again more frequently affected than women in a general ratio of about 2 to 1. However when the side affected is considered there appears to be only a slight preponderance of lesions on the left side the general ratio being about 1.3 to 1.

Therefore if it is accepted that hypernephromas occur with possibly slightly greater frequency in the left kidney then it is not mere coincidence that the overwhelming preponderance of vaginal metastases occur only in the presence of left renal tumors.

The major constant circulatory difference between the two kidneys occurs in the communication of the left spermatic (ovarian) vein with the left renal vein and the comparative shortness of the right renal vein and left renal artery. In view of the well recognized tendency for hypernephromas to invade the renal veins, it seems a fair assumption that the left ovarian vein offers the avenue by which the ovarian involvement occurred in our patient and by which vaginal involvement occurs in the majority of reported instances.

The occasional reported instance of uterine involvement is also probably similarly explainable. The free anastomosis between the left ovarian vein the pampiniform plexus, the uterovaginal venous plexus and its more distal anastomoses as shown by Kownatzki and others, offers a logical explanation for the vaginal dissemination of the tumor in our case. The demonstration of venous tumor emboli in

the vaginal metastases in our patient offers support to this explanation as opposed to a possible lymphatic mode of spread which is espoused by some authors. The theory of implantation on the vaginal mucosa of tumor cells passed in the urine as suggested by Shar-noff possesses little if any corroborative evidence.

One cannot help but entertain the suspicion that if the theory is correct that the left spermatic (ovarian) vein offers the route for retrograde metastasis of hypernephroma to the vagina then it should follow logically that left testicular metastasis must occur with equal or possibly greater frequency in men afflicted with left sided hypernephroma and would be recognized if looked for.

According to this and similar studies hypernephroma metastases to the vagina may be considered as rare lesions. We suspect however that their rarity is overevaluated. Similar instances undoubtedly occur are recognized but are not reported. The 2 cases mentioned by Wharton illustrate this point.

All patients in this study with the exception of Crager's patient Fleischmann's second case and our patient died within 24 months following the recognition of the vaginal lesion. Fleischmann's and Crager's patients both deserve special comment. The diagnosis of hypernephromatoid tumor was made on biopsy of the vaginal tumor of Crager's patient. However it was not definitely determined whether this represented a benign or a malignant process. The patient was seen again 16 months later with the story of having noted a left sided abdominal swelling for 6 months. Cystographic studies were negative but left nephrectomy revealed a hypernephroma. The patient was living and well 4 months after the nephrectomy and 21 months from the time of the original biopsy of the vaginal tumor.

Fleischmann's second patient was seen January 9, 1918 for vaginal bleeding from a small ulcerated nodule which was removed from the left posterior vaginal wall. Definite diagnosis was not made from the biopsy and the lesion was considered as a possible adenoma or baculum. Three months later a left lumbar tumor was discovered when patient was examined for left hypochondriac pain. Left neph-

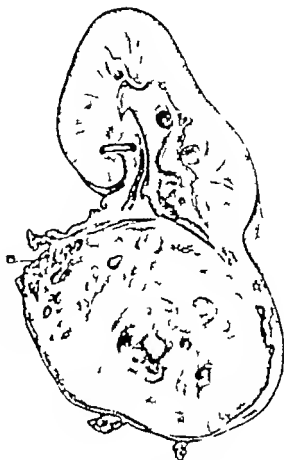


Fig. 9. Longitudinal section of left kidney with inferior pole neoplasm. Tumor had perforated capsule at *a* and involved parietal peritoneum.

rectomy was done 5 months later following deep x ray therapy and several new vaginal nodules were also removed. The renal tumor was a hypernephroma and the vaginal nodules were recognized as similar to the renal lesion. Intermittent x ray therapy was given to local and remote manifestations of the disease. Death occurred May 19, 34 years 8 months after the lesions were recognized as hypernephroma.

In view of the foregoing and since an occasional patient comes to autopsy and reveals no other metastases than the vaginal lesion as illustrated by Graefenberg's first case it appears justifiable to operate in such instances provided no other signs of metastases are demonstrable. Furthermore on the basis of the experiences of Crager of Fleischmann in his second case of Graefenberg in his first case of Hirsch-Hoffmann and of our own experience one is led to the conclusion that in the absence



TABLE L—SUMMARY OF REPORTED CASES OF HYPERNEPHROMA METASTASES TO VAGINA\*—Continued

Author	Date	Original clinical symptoms	Original vaginal metastasis, number and site	Hematuria	Age	Approximate duration of symptoms prior to diagnosis	Duration of life after diagnosis	Side of involved kidney Remarks
16. Sharnoff and Sala	1935	Abdominal mass	Single, anterior wall behind external urethral meatus	?	Not given	5-6 months	6-7 months	Autopsy: left hypernephroma
17. Sharnoff and Sala	1936	Hematuria	Single, right labium minores	?	57	8 years	8 days	Autopsy: right hypernephroma and other metastases
18. Sharnoff and Sala	1936	Mass in upper left abdomen	Mass filling right vaginal fornix	?	5	6 months?	3 months	Left nephrectomy attempted, not successful. Biopsy of renal tumor: hypernephroma
9. Pardoll	1936	Left sided tumor	Left vulva and vagina		30	1 month	6 months	Left nephrectomy for hypernephroma. Autopsy: other metastases present
20. Harwood	1936	Vaginal bleeding. Right inguinal tumor	Single. Ant. vagina.		56	?	?	Left nephrectomy for renal tubular carcinoma. Vaginal tumor and right inguinal node similar histology
1. Taussig	1938	Vaginal bleeding	Single. Left anterior wall, sub-urethral		43	3 weeks	?	Nephrectomy for left hypernephroma. Patient living at time of demonstration
22. Kuznetsov and Feischei	1941	Cough and chest pain, 6 months	Single. Anterior right vaginal wall	0	40	6 months	4 months	N. autopsy. N. nephrectomy. Palpable left kidney. Pyelography slight elongation left upper calyx. Histologic diagnosis vaginal tumor: vaginal cancer metastatic from hypernephroma
23. Martzloff and Alachov	1948	Vaginal bleeding	Multiple, scattered	? See text	57	5 plus months	23 plus months	Nephrectomy for left lower pole hypernephroma. Lived 20 mos. from onset of symptoms

\*Cases have been considered acceptable for tabulation if vaginal lesion showed histologic presence of hypernephroma although suspected kidney may not have been removed.

of any other conclusive signs and symptoms if a hypernephromatoid lesion is demonstrated in the vagina, one would be sufficiently certain in suspecting the presence of a left hypernephroma to warrant surgical exploration of the left kidney.

Radiation therapy as used in treating some of the patients reported in the literature covered by this study, with the possible exception of Fleischmann's patient, did not appear to be of material benefit.

Numerous authors place considerable stress on the apparent predilection of the hypernephromatous vaginal metastases to appear on the left anterior vaginal wall near the external urethral meatus and they are of the opinion that bleeding from this source may be the first sign of mischief. Reference to Table I reveals that of the 23 cases tabulated, 11 patients complained of vaginal bleeding as an original symptom, 8, however, apparently did not bleed and in 4 no statement is reported.

The anterior vaginal wall of the region near the external urethral meatus was the site of a

single primary metastatic tumor 12 times. This tumor appeared to the left of the midline in 8 instances, to the right in 1 and apparently at the midline in 3. Probably no further generalizations can be drawn other than, as pointed out by Taussig, tumors which metastasize to the vagina, presumably via the blood stream, often show a predilection for localization in the distal vagina and frequently in its anterior aspect near the external urethral meatus.

#### SUMMARY

A case is reported in which bleeding from vaginal metastases was the first symptom of an unsuspected left renal hypernephroma. The case presumably represents the 23rd instance of vaginal metastases complicating hypernephroma reported in the literature. The complication is generally limited to tumors of the left kidney, although exceptions are reported.

All patients with hypernephroma complicated with vaginal metastases whose ultimate outcome is known died as the result of the

TABLE 1 SUMMARY OF REPORTED CASES OF HYPERNEPHROMA METASTASIS TO VAGINA

No.	Sex	Age	Color	Size	Weight	Measurements	Remarks	Disposition	Remarks
1	Male	10	Black	10	10	10	10	10	10
2	Female	10	Black	10	10	10	10	10	10
3	Male	10	Black	10	10	10	10	10	10
4	Female	10	Black	10	10	10	10	10	10
5	Male	10	Black	10	10	10	10	10	10
6	Female	10	Black	10	10	10	10	10	10
7	Male	10	Black	10	10	10	10	10	10
8	Female	10	Black	10	10	10	10	10	10
9	Male	10	Black	10	10	10	10	10	10
10	Female	10	Black	10	10	10	10	10	10
11	Male	10	Black	10	10	10	10	10	10
12	Female	10	Black	10	10	10	10	10	10
13	Male	10	Black	10	10	10	10	10	10
14	Female	10	Black	10	10	10	10	10	10
15	Male	10	Black	10	10	10	10	10	10
16	Female	10	Black	10	10	10	10	10	10
17	Male	10	Black	10	10	10	10	10	10
18	Female	10	Black	10	10	10	10	10	10
19	Male	10	Black	10	10	10	10	10	10
20	Female	10	Black	10	10	10	10	10	10

ulcerated surfaces need, of course, to be removed. If marked inflammatory changes are present around the fistula or in the skin externally, operation should be postponed until the structures involved have been restored to a state as nearly normal as possible and with no evidence of active infection. As a part of the preoperative study the condition of the upper urinary tract is investigated always by intravenous pyelograms or ureter catheterization or both. In cases of active bladder infection, the latter may be withheld until the acute infectious process has subsided. It is important to determine the patency of the ureters and to learn whether or not they are dilated, and it is essential to know in advance of the operation the condition of the kidneys and their functional value. One of our patients had congenital polycystic disease. Two of our patients with vesicovaginal fistula had also a ureterovaginal fistula. In our experience the communication between the ureter and the vagina is always associated with complete ureteral stricture below this level and usually is accompanied by some dilatation and infection in the ureter and kidney above.

In some cases of vesicovaginal fistula in which there is danger of ureteral injury during the plastic repair, it is wise to place catheters within the ureters at the start of the operation. In certain difficult cases we have catheterized the fistula itself as an aid in the dissection. We have occasionally encountered a small fistula in the posterior lip of the internal sphincter margin or in the urethra just beyond that could not be found until a ureteral catheter was passed upward through the opening in the vagina below.

#### SUTURE MATERIAL

In 1834 Montague Gosset of London successfully closed a vesicovaginal fistula with gilded silver wire sutures. In 1849 J. Marion Sims closed Anarcha's vesicovaginal fistula with silver wire sutures at the thirtieth operation, having failed twenty nine times with all the suture material he had previously utilized. The great advantages of silver wire are that it causes no inflammatory reaction in the tissues and that it is said to repel infection. The disadvantages are that it has low tensile strength

it cannot be tied; it must be fixed by twisting, and it may produce a disfiguring local argyria. In recent times a metal rustless alloy steel wire has come into use. Primarily recommended by W. Wayne Babcock of Philadelphia for the suturing of septic wounds, and recommended by him in the closure of vesicovaginal fistulas, this alloy wire has all the advantages of silver wire and none of its drawbacks. It is soft, strong, nonirritating and does not discolor the tissues. The tensile strength is such that a very fine gauge suture may be used and a strong knot may readily be tied. A century ago when vesicovaginal fistulas were first closed, there was but one operative technique which consisted of paring the edges of the fistula and approximating them in one layer with sutures. It is obvious that metallic sutures by their strength and lack of irritation offered great advantages in that type of operation. With the development of surgical technique in general and of the operation for vesicovaginal fistula in particular, certain striking changes have occurred. Nowadays in the closure of difficult fistulas the bladder and the vagina are separated from each other and each structure is freely mobilized. Because of this dissection, the edges of the bladder and the vagina may be brought together without tension by fine suture material. Fine chromic catgut can be used successfully in this type of operation while the larger strands of catgut failed in the classical Sims procedure. A method that has frequently proved advantageous in our hands consists of closing the bladder with fine chromic catgut sutures, avoiding the mucosa, and of closing the vaginal wall with alloy wire or silver wire sutures. In our opinion, silk and cotton have no place in the management of these fistulas. When working through the vagina in closing a vesicovaginal fistula in layers it is important not to resect the edges of the vaginal wall before approximating them so as to avoid all tension, and to have sufficient vaginal wall with which to work should a recurrence develop requiring still another operation.

#### VARIETY OF OPERATIONS

On account of the great variety of vesicovaginal fistulas met in clinical practice nu





chromic catgut, depending upon the amount of scar tissue present. Great care is used in placing this first layer of sutures, which must accomplish complete approximation without tension. The defect in the bladder is now closed in one or two layers. When the thickness of its wall is adequate, the muscle alone is brought together with interrupted sutures of No 00 chromic catgut after which the mucosa may be approximated with a continuous suture of double zero or triple zero chromic catgut. The bladder and vaginal suture lines may be planned when possible to lie in opposite directions but the bladder must be repaired always in a way that will result in a minimum of ureteral and urethral disturbance.

When the plastic procedure has been completed, the ureteral catheters are removed and the bladder is closed anteriorly with continuous fine plain catgut in two layers leaving a mushroom catheter, size 26 French in the upper pole of the incision for constant suprapubic drainage of urine. The catheter is irrigated gently with normal saline to be sure that it functions well. A small rubber tissue drain is placed on each side of the bladder to emerge through the prevesical space at the lower angle of the wound. The rectus muscles are approximated above and especially below the suprapubic catheter with interrupted sutures of fine plain catgut. The rectus fascia is closed with interrupted zero chromic catgut. Silk stay sutures may be used if desired. A suprapubic sinus thus formed will heal promptly when the drainage tube is removed. The stubborn sinuses are those which have been placed low in the bladder and just above the symphysis. The catheter should lie high in the wound and high in the bladder where it will produce no irritation near the plastic repair.

Sterile constant urinary drainage is maintained with meticulous care. Bladder distention must be avoided but irrigations are not used unless necessary. The best insurance against obstruction is a high fluid intake. Penicillin and sulfadiazine are given to combat infection. The drains in the prevesical space are removed usually in 4 or 5 days. The suprapubic catheter is taken out in 3 or 4 weeks and in most cases the patient is kept in bed during all of that time.

#### SUPRAPUBIC BLADDER DRAINAGE IN VESICOVAGINAL FISTULA

Drainage of the bladder through a suprapubic incision is a common urological procedure, but a review of the chapter on vesicovaginal fistula in most of the important text books of gynecology fails to show any mention of this method of diverting the urinary stream after operations for vesicovaginal fistula. Suprapubic drainage has been described as a part of the intravesical operation that we have presented. We wish to emphasize its advantage also in difficult cases of vaginal repair. We use it frequently and regard it as one of the most important advances that we have made in the management of this problem. Diversion of the urinary stream is of obvious benefit during the process of healing and the suprapubic tube affords more certain drainage than the urethral catheter. Properly placed, it will remain in position; it is less likely to become obstructed and it will not produce irritation in the region of repair. It is especially important in those cases in which the fistula involves the urethra. Suprapubic drainage adds but little to the difficulty and shock of the operation. It is established immediately following the vaginal procedure in many instances in our clinic. Healing seems more certain; the care of the perineum is more satisfactory and a well constructed suprapubic sinus never fails to close promptly in the presence of a normal bladder outlet. In the 40 cases of vesicovaginal fistula reported 13 patients 32.5 per cent had suprapubic drainage 4 after the intravesical operation and 9 after the vaginal procedure. We are convinced from our experience that the more common use of this method of drainage would lead to happier results in the management of difficult urinary fistulas.

#### SCHUCHARDT INCISION

Schuchardt's incision, also known as the paravaginal incision, was proposed in order to facilitate through better exposure, the radical vaginal operation for carcinoma of the cervix. It is also of great value in exposing a vesicovaginal fistula situated high in the vagina, especially that which follows a panhysterectomy and which is situated in a scarred retracted vaginal vault. It is usually performed on the

merous methods of closure have had to be devised. These may be summarized as follows:

1. The vaginal procedure including several varieties of technique.

A. Paring the edges and closing them in one layer with silver wire or alloy wire sutures.

B. Circumcising the fistulous opening turning a cuff into the bladder, closing the fistula by approximating the bladder musculature over the cuff without penetrating the bladder mucosa and closing the vaginal wall separately. The vaginal wall may be satisfactorily closed by means of metallic sutures placed perpendicularly to the line of bladder suture thus staggering the suture lines.

C. Mobilizing the bladder and closing the bladder and vagina in separate layers.

D. Using the cervix and body of the uterus to close the opening.

E. Suturing pedicled flaps from the vagina and vulva to bridge over the defect.

F. Using the gracilis muscle as a pedicle flap (Garlock technique).

G. Colpocleisis.

H. Partial colpocleisis—Latzko.

2. The intravesical procedure through a suprapubic incision (Phaneuf and Graves) described and illustrated herein.

3. The suprapubic extraperitoneal procedure through a Pfannenstiel incision.

4. The intraperitoneal procedure through an abdominal incision (Leguen technique).

5. Implantation of ureters in the sigmoid.

#### THE INTRAVESICAL CLOSURE OF VESICOVAGINAL FISTULA

It is a well known fact that almost all vesicovaginal fistulas may be closed by the vaginal approach. There are, however, a certain few vesicovaginal fistulas so situated that they cannot be seen or exposed through the vagina. It is for this small group of cases that we have devised a method of intravesical closure which we are describing and illustrating as follows.

*Operative procedure.* The Trendelenburg position is used. A midline suprapubic incision beginning low over the symphysis, exposes the extraperitoneal region of the bladder by separating the rectus muscles. Careful dissection of these muscles serves as a useful guide in approaching this region when normal

cleavage planes have been obliterated by the scar of a previous operation. Separation of the recti from their sheaths on each side along the line of incision also adds to the ease of retraction. The fat and fascia overlying the bladder are divided beneath the symphysis and the anterior peritoneal reflection is dissected gently upward to expose in its entirety the anterior vesical wall. The sides of the bladder are then separated from adjacent fat or scar as far downward as the region of the bladder neck. This free mobilization is very important and makes it possible to obtain a very satisfactory intravesical exposure of the area occupied by the fistula.

The bladder is opened in the anterior midline by an incision long enough and low enough to permit an adequate view of its cavity when a self retaining retractor has been placed in position. A curved ribbon or tongue-depressor retractor held against moist gauze in the dome of the bladder helps to draw the region of the trigone and the fistula upward into the field. Ureteral catheters usually of size 5 or 6 French, are now passed through the ureteral orifices to define the position of the ureters accurately during the operation. The internal orifice of the urethra is carefully observed and it also must be protected against injury. Silk traction sutures are placed in the bladder around the fistula, as shown by the artist, about 0.5 centimeter from the edge of the opening. These sutures held upward, one at a time by the operator or his assistant, help greatly in the subsequent dissection.

The margin of the fistula is incised around its circumference with a small No. 15 Bard Parker blade and the whole thickness of the bladder wall is carefully separated from the vagina in all directions. The separation is carried out widely enough to permit the final repair of these structures without tension. Care must be used to avoid the ureters and further vaginal injury. In one difficult case, in which the fistula lay close to the outlet of the bladder the operator placed fingers of the left hand in the vagina to guide the dissection which in this region must preserve the urethral musculature. When bladder and vagina have been well mobilized the vaginal opening is closed with interrupted sutures of No. 0 or No. 00

chromic catgut, depending upon the amount of scar tissue present. Great care is used in placing this first layer of sutures which must accomplish complete approximation without tension. The defect in the bladder is now closed in one or two layers. When the thickness of its wall is adequate the muscle alone is brought together with interrupted sutures of No. 00 chromic catgut, after which the mucosa may be approximated with a continuous suture of double zero or triple zero chromic catgut. The bladder and vaginal suture lines may be planned when possible to lie in opposite directions but the bladder must be repaired always in a way that will result in a minimum of ureteral and urethral disturbance.

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Sterile constant urinary drainage is maintained with meticulous care. Bladder distention must be avoided but irrigations are not used unless necessary. The best insurance against obstruction is a high fluid intake. Penicillin and sulfadiazine are given to combat infection. The drains in the prevesical space are removed usually in 4 or 5 days. The suprapubic catheter is taken out in 3 or 4 weeks and in most cases the patient is kept in bed during all of that time.

#### SUPRAPUBIC BLADDER DRAINAGE IN VESICOVAGINAL FISTULA

Drainage of the bladder through a suprapubic incision is a common urological procedure but a review of the chapter on vesicovaginal fistula in most of the important text books of gynecology fails to show any mention of this method of diverting the urinary stream after operations for vesicovaginal fistula. Suprapubic drainage has been described as a part of the intravesical operation that we have presented. We wish to emphasize its advantage also in difficult cases of vaginal repair. We use it frequently and regard it as one of the most important advances that we have made in the management of this problem. Diversion of the urinary stream is of obvious benefit during the process of healing and the suprapubic tube affords more certain drainage than the urethral catheter. Properly placed, it will remain in position; it is less likely to become obstructed and it will not produce irritation in the region of repair. It is especially important in those cases in which the fistula involves the urethra. Suprapubic drainage adds but little to the difficulty and shock of the operation. It is established immediately following the vaginal procedure in many instances in our clinic. Healing seems more certain; the care of the perineum is more satisfactory and a well constructed suprapubic sinus never fails to close promptly in the presence of a normal bladder outlet. In the 40 cases of vesicovaginal fistula reported 13 patients 32.5 per cent had suprapubic drainage 4 after the intravesical operation and 9 after the vaginal procedure. We are convinced from our experience that the more common use of this method of drainage would lead to happier results in the management of difficult urinary fistulas.

#### SCHUCHARDT INCISION

Schuchardt's incision also known as the paravaginal incision was proposed in order to facilitate, through better exposure, the radical vaginal operation for carcinoma of the cervix. It is also of great value in exposing a vesicovaginal fistula situated high in the vagina, especially that which follows a panhysterectomy and which is situated in a scarred retracted vaginal vault. It is usually performed on the

left side, and the length of the incision is governed by the amount of room required. We have found this procedure to be extremely valuable. It was used in 11 of the 40 cases included in this study or in 27.5 per cent.

#### POSTOPERATIVE CARE

Regardless of the type of operation employed in cases of vesicovaginal fistula, the postoperative care is of vital importance. It requires close supervision preferably by the operator himself and it never should be delegated to inexperienced assistants. The primary consideration is the avoidance of bladder distention and infection during the period of healing. Every precaution must be taken to prevent interruption of catheter drainage. The suprapubic or urethral catheter must be maintained unobstructed and in good position. As has been stated we prefer suprapubic drainage in the difficult cases. Irrigations always gentle and without bladder distention are used as little as possible to minimize the risk of the introduction of fresh infection. Vigorous antiseptic solutions productive of irritation or discomfort, are unnecessary. Potassium permanganate solution is used most often in our cases. The best and safest irrigation is provided by an adequate fluid intake. It is not necessary to irrigate a catheter that is freely discharging clear urine. Until the patient is able to take by mouth and retain an average of 2500 to 3000 cubic centimeters of liquids each day parenteral fluids are essential. These will vary in amount and kind with the general state of the patient and her circulatory condition.

Infection in the bladder and vagina is always reduced to the minimum before surgery is undertaken in these cases. Bacteriological study of the urine is made at the time of the original examination and as often as indicated during the convalescence. The antiseptic program is based upon these cultures. Sulfadiazine is given usually a few days before operation 0.5 gram every 4 hours day and night, combined with sodium bicarbonate 1.0 gram and continued for several days after operation. When it is apparent that infection is well controlled these medicines may be given at 6 hour intervals and we omit them entirely in

most cases within 7 to 10 days after surgery to avoid occlusion of the catheter with alkaline deposits. For the remainder of the convalescence the patient receives methenamine and sodium biphosphate, 15 grains of each 4 times daily. Indwelling catheters become obstructed less quickly when the urine is acid. Penicillin is used as a rule for the first few days after operation until the temperature is normal and the wound is healing well. We resort to streptomycin whenever necessary. It is important to remember that this drug has been shown to be more effective in an alkaline urine.

Urethral catheters are removed as a rule in about 14 days. Suprapubic catheters are allowed to remain for 3 to 4 weeks. When metallic sutures have been resorted to in closing the vagina they are removed at the end of 4 weeks always under anesthesia. Intravenous anesthesia serves a useful purpose in this connection but general anesthesia may be employed if preferred. The patient is permitted to get out of bed the day after the drainage apparatus is removed. When urethral drainage is employed she may be allowed to go home on the 15th postoperative day to return to the hospital in 2 weeks or in 1 month from the time of the operation to have the metallic sutures removed, if wire has been used.

#### URETEROINTESTINAL ANASTOMOSIS FOR IRREPARABLE FISTULAS

An occasional case of vesicovaginal fistula is encountered in which there seems to be little likelihood of achieving urinary control by any of the described procedures. In such cases it is desirable in some instances, to resort to transplantation of the ureters to the large bowel. The most common reasons for this operation are first destruction of the bladder sphincter which will render the patient still incontinent, even though the fistula be repaired, and second, necrosis leading to fistula as a result of irradiation. Ischemia, produced by radium or x ray with endarteritis and fibrosis around the periphery of a fistula, does not present a favorable field for plastic surgery.

There have been 6 patients in this series who have had ureterointestinal anastomoses. Two had urethrovaginal fistulas with severe urethral injury and loss of the sphincter mus-

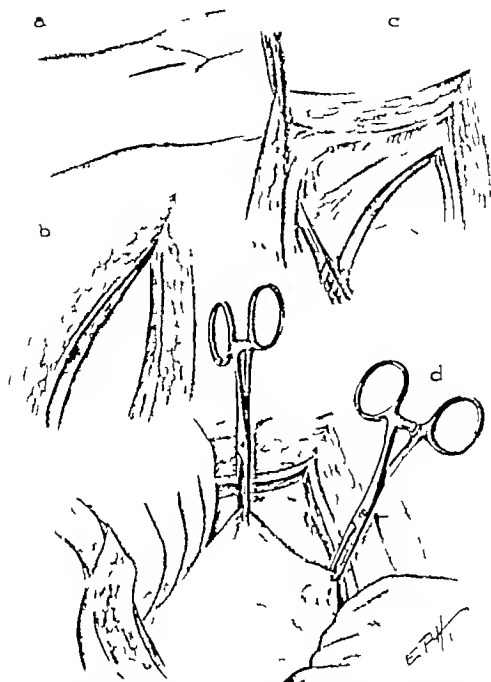


Fig 1. Artist's drawing a, Median suprapubic incision between the symphysis and the umbilicus. b The incision is carried down to the fat overlying the peritoneum and the anterior bladder wall. c The medial portion of the rectus muscle on each side is exposed and freed anteriorly and posteriorly down to the symphysis to permit wide retraction. d The bladder wall is grasped with Allis clamps after dividing the fatty layer which covers it. The anterior peritoneal reflection is dissected upwards.

culature. Two had very complicated problems that were seen before the development of the suprapubic operation that we have described. Another patient had an irradiation fistula following the treatment of carcinoma of the cervix. Still another had tuberculosis in the bladder and but one functioning kidney. The clinical result has been gratifying in all of these cases. Their records are abstracted briefly.

Mrs D.B. aged 46 years, Carney Hospital No 361467 was admitted May 28, 1936. There was a history of vesicovaginal fistula following hysterectomy for fibroids. A second operation had been attempted to close the fistula and at this time a strictured right ureter was tied. Suprapubic operation was performed by us June 9, 1936. The right half of the bladder was removed. Pathological report was tuberculosis. Incontinence persisted.

Left nephrostomy on December 9, 1937, was carried out to afford preliminary drainage and to reduce

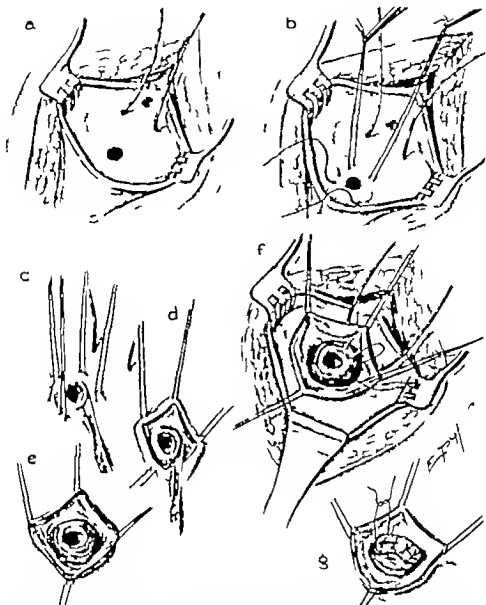


Fig. 17g. Artist drawing. a, The bladder has been opened in the mid line and a self-retaining retractor has been introduced. The urethral orifice is seen and ureteral catheters have been passed. The fistula is exposed but the artist has placed it higher than the usual position. b, Four traction sutures of fine black silk are introduced. The dissection is begun by locking the margin of the fistulous opening. c, The bladder is carefully separated from the vagina with fine scalpel. The dissection is completed. There is free mobilization of the bladder and vagina. f, The vaginal opening is closed with interrupted sutures of No. 1 or 00 chromic catgut. g, The vaginal portion of the fistula is closed.

the risk of ureteral transplantation in the case of a single kidney. Left ureterointestinal anastomosis was performed on January 15, 1938. The result was satisfactory. The patient had a spinal fusion operation for tuberculosis in December 1934 with no untoward complications. She was last seen on December 16, 1947, almost 10 years after uretero-

intestinal anastomosis at age 58 years. She reported a good appetite. Her weight had remained the same for several years. She was drinking about 3 quarts of liquids every day and said that there had been no diminution in her rectal output. The intervals between voidings were sometimes 2 to 3 hours by day, nocturia once. She looked very well. Her color was

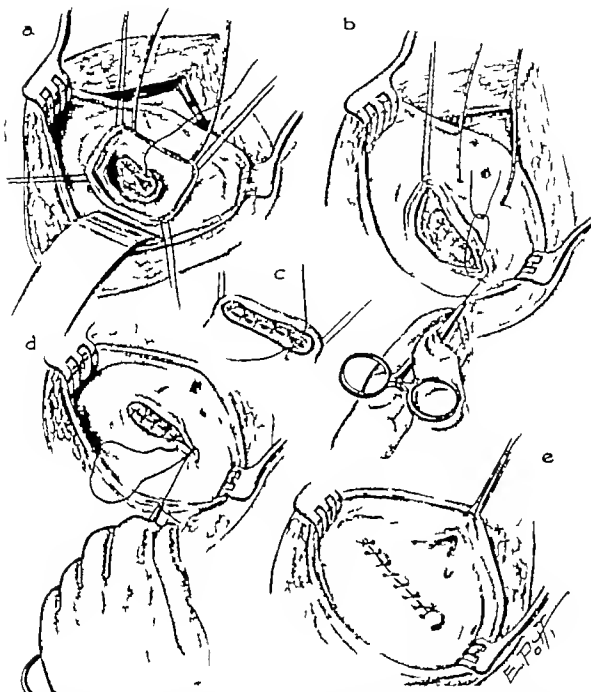


Fig. 3. Artist's drawing. a. A second layer of interrupted sutures of No. 00 chromic catgut is applied in the vaginal wall when possible. Because of tension this layer has to be omitted in some cases. b. The closure of the bladder is begun with interrupted sutures of No. 00 chromic catgut in the bladder musculature, avoiding the mucosa. c. The closure of the muscular layer is completed. d. The bladder mucosa is closed with a running suture of No. 00 or 000 chromic catgut. e. The vesicovaginal fistula is now closed. The urethral and ureteral orifices are uninjured.

good. Blood pressure 155/75. The abdomen was not remarkable except for weakness of its wall in the regions of the scars. Fasting nonprotein nitrogen was 62 milligrams. The nonprotein nitrogen was 57 milligrams in April 1944. Intravenous pyelograms showed faint excretion of dye by the left kidney in 25 minutes with evidence also of some dye in the sigmoid. This appears to have been a satisfactory clinical result in a difficult problem in spite of present sign of impaired renal function.

Mrs. G. H., aged 40 years, Carney Hospital No. 381817 was admitted June 15, 1938. History of panhysterectomy for pelvic inflammatory disease followed by a vesicovaginal fistula and two unsuccessful repair operations. At examination a large fistula was found close to the ureters and heavily incrustated with urinary salts. A suprapubic cystostomy was performed first to prepare the bladder and vagina for subsequent plastic surgery. Uretero-intestinal anastomosis was refused. Colpocleisis was





Fig. 4. Anterior bladder closure. a, The anterior bladder is closed in two layers with running extra-mucosal sutures of No. 1 plain catgut. b, A mushroom catheter size about 26 French drains the bladder to the apex of the incision. c, and d, The wound is closed. Small rubber tubes (French drains) each side of the bladder, and the prevesical space at the lower angle of the wound. The rectus muscles are approximated above and below the catheter with interrupted sutures of fine plain catgut. The rectus fascia is closed with interrupted sutures of No. 0 chromic catgut.

done by Dr Phaneuf on August 3, 1938 and secondary closure of small point of urinary leakage on October 14, 1938. Patient was discharged November 13, 1938 voiding normally incontinence relieved.

She returned to the hospital in 1939 because of domestic difficulties arising from the interruption of normal marital relations. Left retrointestinal anastomosis was performed on November 7, right ureterointestinal anastomosis on February 5, 1940.

vaginal plastic operation to reopen the vagina, by Dr Phaneuf March 2, 1940. Patient was last seen in the office on November 4, 1942. She had been perfectly well. Complete examination was not possible because she was leaving for California the next day. She looked well, had good color and a clean moist tongue. The abdomen was essentially normal. Intravenous pyelograms in July 1944, showed excretion of the dye by both kidneys in 5 minutes.

There was moderate dilatation on the right side. The clinical result seemed satisfactory.

Mrs. B C. aged 37 years, Carney Hospital No. 394470 was admitted December 2, 1939. There was a history of panhysterectomy in August 1930 followed by vaginal fistula. After an attempt to close this in October 1939 the patient had developed an enterovaginal fistula. Carney Hospital diagnosis after urological study was fistulas—vesicovaginal, enterovaginal and ureterovaginal left. Closure of enterovaginal fistula was carried out by Dr. Phaneuf on December 13, 1939. The fistulous tract was found to lie between the vaginal cuff and an adherent loop of ileum.

Right ureteroileostomal anastomosis was done on March 28, 1940. Left ureteroileostomal anastomosis on July 30, 1940. Patient was last seen in September 1947, over 7 years after the ureteral transplantations. Her general condition was excellent. Fasting non-protein nitrogen was 40 milligrams. Intravenous pyelograms showed excellent excretion of the dye by both kidneys in 5 minutes. There was slight dilatation on the left side. The clinical result seemed very satisfactory.

Mrs. E B. aged 35 years, Carney Hospital No. 381424 was first seen in January 1938 when a urethrovaginal fistula followed operation for the removal of a large infected cyst or diverticulum of the urethra. Immediate repair was attempted without success. Suprapubic cystostomy and plastic operation upon the outlet of the bladder was done in November 1938. Incontinence persisted. Patient continued to wear suprapubic tube. Plastic reconstruction of the urethra was carried out in June 1941 without success. Hysterectomy was performed by Dr. Phaneuf for fibroids and endometriosis and chronic salpingo-oophoritis in July 1942.

Left ureteroileostomal anastomosis was performed on September 16, 1943. Right ureteroileostomal anastomosis on July 17, 1944. Patient was last seen in July 1947. Nonprotein nitrogen was 40 milligrams on July 10 and 28 milligrams on July 15. Blood pressure was 130/90. Intravenous pyelograms showed the dye to be excreted by both kidneys in 5 minutes. There was slight dilatation of the renal pelvis and ureter on each side (Fig. 5). The clinical result seemed satisfactory.

Mrs. A S. aged 52 years, Carney Hospital No. 446056 was admitted November 30, 1944. There was a history of cauterization of a urethral caruncle in 1939. This was repeated in 4 months and to continence followed. There had been 4 unsuccessful attempts to repair the urethra between 1940 and 1943. Examination at the Carney Hospital revealed the urinary meatus lined with slough. The anterior vaginal wall was intact but scarred. Urethral destruction considered too complete for further plastic surgery.

Right ureteroileostomal anastomosis was performed on September 22, 1944. Left ureteroileostomal anastomosis on May 1, 1945. Patient was last seen in October 1947. Nonprotein nitrogen was 42 milli-



Fig. 5. Intravenous pyelogram in case of Mrs. F. B. Carney Hospital No. 381424, three years after ureteroileostomal anastomosis.

grams on October 6 and 32 milligrams on October 10. Intravenous pyelograms showed the dye to be excreted by each kidney in 5 minutes. There was slight dilatation on the right side. The clinical result seemed very satisfactory (Figs. 6, 7, 8 and 9).

Mrs. B E. aged 65 years, Carney Hospital No. 464687 was admitted September 9, 1946. There was a history of large vesicovaginal fistula beginning in September 1944 following a program of x-ray therapy and radium completed in August 1943 for the treatment of epidermoid carcinoma of the cervix, grade 3. There had been one unsuccessful attempt to close the fistula by a vaginal operation combined with suprapubic drainage. Examination by the authors disclosed no evidence of persistent malignant disease. The vagina was 1 to 3 centimeters in length. The urethra was absent except for its distal third. Cystoscopy found the region of the trigone to be replaced by an area of slough and necrosis.

Exploratory laparotomy to exclude persistent cancer and right ureteroileostomal anastomosis was performed on September 23, 1946. Left ureteroileostomal anastomosis on October 17, 1946. The immediate result was very satisfactory. A letter received from the family physician in July 1947 stated: Her general condition is excellent. Except for the times when she is nervous and upset, her control is excellent. The blood pressure was 140/86. The non-protein nitrogen was 29. The intravenous pyelograms showed no evidence of either hydronephrosis or hydroureter.

The whole problem of ureteroileostomal anastomosis and the technique employed at the

SUMMARY OF METHODS USED IN CLOSING  
THIRTY-FOUR FISTULAS

	No.
Sim's classic ligation (Cases 2, 3, 2, 5)	5
Suprapubic extra-peritoneal closure. Later vesical implantation or right ureter (Case 5)	
Vaginal flap method (Cases 4, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30, 31, 32, 33, 34)	20
Transplantation of ureters in sigmoid (Cases 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30, 31, 32, 33, 34)	6
Colpocleisis (Case 3)	
Colpocleisis and later transplantation of ureters in sigmoid (Case 4)	
Implantation of right ureter in bladder neovagina. pubic intravesical closure (Case 28)	
Suprapubic intra-vesical closure (Cases 30, 31, 32, 33)	3
Vaginal flap method. Reconstruction of rectum (Cases 3, 33)	2
Total	40

\*The sigmoid flap method consists of making a sigmoid incision through or around the fistula, developing its sigmoid flaps, mobilizing the bladder, closing the bladder opening with fine catgut and the sigmoid incision distal or where alloy wire or tent.

†Case 4. Vaginal closure by another surgeon after failure at the Carney Hospital.

Carney Hospital will be discussed in a later communication from the Urological Department.

## RESULTS

There was no fatality in this series of 40 cases. The end result in 39 cases showed the patient to be cured. The case of 1 patient is not completed. A short summary follows.

CASE 36. Mrs. B. T. had a large vesicovaginal fistula about 3 centimeters in diameter. This had occurred on March 9, 1938, as a result of the high forceps delivery of her third child, a large male child who had died at birth. This delivery had been complicated by puerperal sepsis. The fistula which was situated high under the symphysis pubis could not be exposed for closure through the vagina. She also had a myomatous uterus the size of a 3 month gestation. The patient was operated upon at the Carney Hospital on June 18, 1946, a panhysterectomy and double salpingo-oophorectomy being performed. She made a satisfactory recovery. On October 18, 1946, she had an intravesical closure of the fistula by the method which we have presented under continuous spinal anesthesia. This was the most difficult operation for vesicovaginal fistula that we had thus far performed. She was discharged from the hospital on December 8, 1946, at which time she voided large amounts of urine at one time on the previous day having passed 15 ounces about 360 cubic centimeters of urine.

Examination at Dr. Phaneuf's office on January 3, 1947, showed the following. The abdominal incision was well healed. On the introduction of a Sims

speculum a small amount of urine was found in the vagina. The vaginal scar which was hidden under the symphysis could not be seen. It was found to be perfectly smooth on palpation. On close observation after some time the escape of a minute quantity of urine was observed as it came from the right side of the scar. Thus the fistula, which originally had been the size of a silver half dollar, had been converted into a pinpoint opening.

The patient has returned to her home in California. A letter received from Dr. Frank Himmann of San Francisco in June, 1947, stated that cystoscopy had revealed a small fistulous opening in the bladder about 4 millimeters in diameter, in the superior portion of the scar on the right side. A functioning right ureter was not found. He felt hopeful that this remaining fistula could be closed successfully.

## ABSTRACT OF CASES

The 5 case abstracts that follow are reported because of their unusual interest.

CASE 13. Mrs. A. S., an obese woman 59 years of age, had had a supravaginal hysterectomy for fibroid in a neighboring state. Sometime thereafter she had bleeding from the cervical stump and operation consisting of excision of the cervix through the vagina, was performed. The trigone of the bladder was removed with the cervix. When she was examined at the Carney Hospital she had a large vesicovaginal fistula which occupied the vaginal vault. The ureteral orifice on each side was caught in the scar and could be seen ejecting urine. On March 25, 1938, a colpocleisis was performed, alloy wire sutures being used. The convalescence was uneventful. On April 13, 1938, the alloy wire sutures were removed. Urinary continence had been established. On May 23, 1938, an examination showed the vagina to be 5 centimeters in depth. The patient had urinary control and was enjoying good health.

CASE 14. Mrs. G. H., 40 years of age and reported previously as a case of uterointestinal stenosis, had been operated on elsewhere on July 20, 1917, the operation consisting of a panhysterectomy and double salpingo-oophorectomy for pelvic inflammatory disease. The bladder had been injured at the time of operation and a vesicovaginal fistula had appeared immediately. On September 1, 1937, she was operated on again by the same surgeon, an abdominal closure of the vesicovaginal fistula being attempted. This was unsuccessful. On December 18, 1937, a vaginal closure of the fistula was undertaken again without success. She was referred to one of us on April 28, 1938, when an examination was made. A lighted speculum placed in the vagina revealed a large fistula at the apex of the vaginal vault. The opening was filled with a mass of urinary concretion. The vulva, the vagina and the inner aspects of the thighs were markedly excoriated. Later urological studies revealed that the left ureteral orifice was close to the margin of the fistula. Much scar tissue had



Fig 6



Fig 7



Fig 8

Fig 6. Intravenous pyelogram before operation in case of Mrs. A.S. Carney Hospital No 446056

Fig 7. Intravenous pyelogram in case of Mrs. A.S. Carney Hospital No 446056 about 3 1/4 years after uretero-intestinal anastomosis, 5 minute film. Note the junction of ureter and bowel clearly shown on the left side.

Fig 8. Intravenous pyelogram in case of Mrs. A.S. Carney Hospital No 446056, about 3 1/4 years after uretero-intestinal anastomosis, 15 minute film. Note the junction of ureter and bowel clearly shown on the left side.

Fig 9. Intravenous pyelogram in case of Mrs. A.S. Carney Hospital No 446056 about 3 1/4 years after uretero-intestinal anastomosis. Note the dye outlining the distal portion of the large bowel.



Fig 9.

formed subsequent to the two previous attempts at closure. The fistula was pulled upward under the symphysis and was inaccessible for closure through the vagina. The patient was given the choice of two methods: transplantation of the ureters into the sigmoid or colpocleisis. It was explained to her that colpocleisis meant the cessation of marital relations. She was emphatic in stating that future marital relations meant nothing to her and she chose the second of the two procedures.

On August 23, 1938, a colpocleisis was performed at the Carney Hospital. This healed except for a small area in the line of suture which allowed the leakage of a small amount of urine externally. On October 24, 1938, this defect was closed successfully. She was now continent and voided through the urethra. Later, however, she became dissatisfied with the cessation of her normal marital life and she demanded that the vagina be reopened. On December 3, 1939, one ureter was implanted in the sigmoid while the second was similarly treated on February 5, 1940. On March 12, 1940, a vaginal plastic operation was performed to reopen the vagina. A large glass dilating plug was introduced in the

vagina and was worn constantly. She was next seen in the office by one of us on April 11, 1940. The vaginal introitus and vagina admitted two fingers. The vesical fistula was readily felt and admitted the tips of the two examining fingers. The vagina was healthy in appearance; there was no irritation present and the operative results appeared to be satisfactory. Coitus had been indulged in. She was advised to discard the glass vaginal plug during the day but to wear it at night. On May 28, 1940, the vagina appeared to be roomy and she was advised to continue to wear the large glass plug at night and to continue with sexual congress. She failed to keep subsequent appointments but returned to the office on Febru-



Fig. 1 Intra-cervical photograph in Case 5. Mrs. M. H. Healed excisional fistula following closure of the kidney and ureterocervical transplant in on the right side.

ary 20 1941. She had not worn the glass plug since August 1940. The vagina was somewhat contracted at the junction of the middle and lower thirds, the middle third admitted to examining fingers. The narrowing was believed to be due to disease. A medium-size glass plug was inserted and he was a kept retained in in month for the introduction of larger one. She was entirely satisfied with her urinary control. She was last seen in May 12 1941 when the follow-up was good. The vaginal introitus readily admitted two fingers the vaginal wall are soft and healthy in appearance. Medium bulbous external speculum can be used without difficulty. The second to the largest glass vaginal plug can be introduced with some difficulty. Urinary control is satisfactory.

CASE 25. Mrs. C. O. T. 42 years of age was operated on at the University Hospital for excisional fistula in October 1 1942. The fistula had developed after an instrumental delivery of her first child. She was premenstrual. Three operations had been performed. Another attempt in an attempt to close the fistula the first operation was performed in 1938 this was not successful. The second operation was performed on August 11 1941 and consisted of vaginal hysterectomy and closure of the fistula which had resulted in failure. The third operation was performed in October 12 1941 and consisted of vaginal closure of the fistula. This also resulted in failure. At the time of her admission to the University Hospital the vagina was contracted considerably enough to require dilation of the vagina through the urethra. The patient was recovered and the day after urinary control was satisfactory. Preliminary measures are necessary to prepare these areas for

surgery. The operation which was performed on October 3 1942 consisted of a left Schuchardt incision and the vaginal closure of the fistula after free mobilization with interrupted sutures. No. 6 chrome catgut placed in the bladder wall in a transverse direction. This completely closed the bladder opening. Next a flap of muscled vaginal tissue was split from the left vaginal wall flap was sutured over the region of bladder repair by means of interrupted sutures of No. 6 chrome catgut. The reinforced bladder suture line. Finally the vaginal mucosa was closed with five interrupted sutures of steel silk wire. The Schuchardt incision repaired and a suprapubic cystostomy was performed. The convalescence was uneventful. The suprapubic catheter was removed on October 11 1942 and the suprapubic sin had healed completely on October 5 1942. The alloy wire sutures were removed on October 25 1942. There was no sign of a fistula and the patient was allowed out of bed on that day. She was examined in the office on December 6 1942 July 5 1943 and May 31 1944. All examinations showing well healed fistula and urinary continence.

CASE 26. Mrs. M. H. 39 years of age had had a paralytic rectum and a double salpingo-oophorectomy at the time of a hysterectomy in April 1942. Shortly after operation a large excisional fistula was found and the patient appeared to be completely cured. A urologist was called for consultation. In addition to the large excisional fistula he discovered ectopy of both ureters at the bladder level. He performed bilateral nephrostomy in April 6 1942 and at this time learned that the patient had congenital polycystic disease of the kidneys. When urinary control began to flow from the vagina through the fistula opening the nephrostomy tubes are allowed to close. Subsequently the surgeon who had done the hysterectomy performed a unilateral operation for closure of the fistula. Neither of these being successful he was referred to the University Hospital for complete urological studies. It was found that the left ureter was patent and that the right ureter was obstructed at about 4 centimeters above the entrance to the bladder. A right ureteral fistula had occurred above the structure and this fistula was in contact with the barter's congenital opening permitting the escape of urine from the right kidney. The first step in our course of treatment was the implantation of the right ureter in the postero-superior portion of the bladder. Healing was satisfactory and the function of the right ureter was demonstrated by roentgen. The next step was an attempt to close the excisional fistula through the vagina on December 14 1944. The orifice of the left ureter was closed with the use of the fistula for this reason a urethral catheter was passed on that date to lessen the likelihood of urethral injury during the operation. A left Schuchardt incision was made. The fistula was carefully exposed there was extensive scar tissue resulting from the first two attempts at closure and the right

end of the fistulous opening was pulled upward and behind the right pubic ramus. It was impossible to separate the vagina from the bladder under these conditions. Therefore the edges of the fistula were pared according to the Sims technique and the opening was closed with six interrupted sutures of No. 30 steel alloy wire. The Schuchardt incision was closed and suprapubic drainage was established. The catheter in the left ureter was left *in situ* for a few days. On January 16, 1945, the six steel alloy wire sutures were removed. There was still a slight escape of urine into the vagina on the right side. The patient was examined at the office on March 7, 1945; there was persistent urinary leakage from the vesicovaginal fistula.

On May 21, 1945, intravesical closure of the fistula was carried out by the authors under continuous spinal anesthesia by the technique described. The patient never passed any urine through the vagina from that time on. Healing took place by first intention. She was allowed to void on the twenty-first day. She was discharged from the hospital on June 21, 1945, the fistula being closed and both kidneys draining into the bladder. Intravenous pyelograms in July 1945 showed fair renal function on each side with good concentration of the dye in the 25 minute film (Fig. 10). Changes in the kidney pelvis due to polycystic disease are seen. The right ureter, which has been transplanted to the dome of the bladder, is shown with no significant dilatation. On August 18, 1945, examination at the office revealed the vaginal vault to be smooth, the anterior vaginal wall to be well healed, the fistula to be closed and the result satisfactory. At the last office visit, April 17, 1947, the patient looked very well and had no symptoms. A voided sample of urine showed no abnormalities microscopically. At abdominal examination both kidneys were found to be palpable and the right one smaller than the left. Blood pressure was 175/85.

#### SUMMARY AND CONCLUSIONS

1. The distressing condition of vesicovaginal fistula originally was due to obstetric causes. The majority of urinary fistulas seen today follow operations on the female pelvic organs. The latter are the more difficult to repair because of their inaccessibility and the firm scar tissue which surrounds them.

2. The first operation on record for the closure of vesicovaginal fistula is that of Mr. Montague Gosset of London in January

1834; he had used gilded silver wire sutures. George Hayward of Boston reported a successful operation in 1839 as well as two others in 1851.

3. J. Marion Sims closed his first vesicovaginal fistula in May, 1849, having operated on the slave girl Anarcha for the thirtieth time and having used silver wire sutures for the first time. It is very probable that Sims knew nothing of the work done in London when he proposed the silver wire suture.

4. The various procedures used in closing vesicovaginal fistulas are tabulated.

5. We are of the opinion that most vesicovaginal fistulas can be closed by the vaginal route.

6. For the few cases in which the fistula cannot be exposed through the vagina, we describe and illustrate an intravesical operation which has given us excellent results.

7. In 6 cases in this series for reasons that have been presented, ureterointestinal anastomoses were performed with satisfactory results.

8. The advantage of suprapubic drainage in the management of difficult vesicovaginal fistulas is emphasized.

9. The preoperative and postoperative care as well as the suture material are discussed.

10. Thirty-four cases (plus Dr. Graves' 6 cases of ureterointestinal anastomosis) with their end results are reported.

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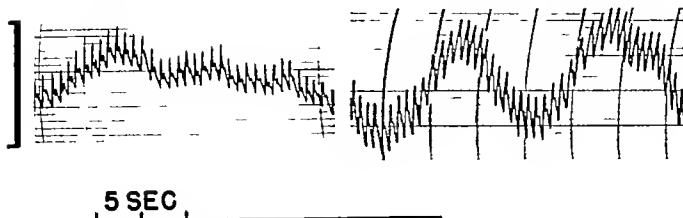


Fig. 1 Toetip plethysmograms tracing from a normal subject on the left, and from a hypertensive subject on the right. Note the differences in both the position of the dicrotic notch and in the amplitude of the alpha waves in both

records (In these and in all subsequent tracings the calibration on the left represents a volume change amounting to 20 cubic millimeters. Spacing between the ordinates equals 5 seconds.)

intervals following both unilateral and bilateral sympathectomy

The plethysmograms were calibrated frequently in order to insure accurate standards for measurement and comparison. The analysis of all the tracings was based on the contour of the volume pulse wave, the amplitude of the volume pulse, the amplitude of the alpha waves, the overall volume and the changes which followed attempted vasodilatation.

In most patients physical examination was supplemented by teleroentgenograms, electrocardiograms and intravenous pyelograms. Retinal changes were evaluated by ophthalmologists. Renal function was determined both by the excretion of diodrast as noted on the pyelogram and by the excretion of phenol sulfonphthalein. The blood pressure was measured sphygmomanometrically at frequent intervals. The changes in blood pressure which followed sodium amytal were measured in all but 7 of the 30 patients who underwent operation.

#### RESULTS

Figure 1 illustrates the plethysmogram of both a normal and an untreated hypertensive patient. Although the volume pulses of both are characterized by a sharp peaked apex, by a distinct dicrotic notch and by a more vertical systolic than diastolic limb, it is to be noted that the dicrotic notch is inscribed nearer to the apex and as a rule the magnitude of the alpha deflections is greater in the hypertensive than in the normotensive subject. The proximity of the dicrotic notch to the apex of the

volume pulse appears to be related to the height of the diastolic pressure since the dicrotic notch is in general found to be at a higher position on the diastolic limb in the presence of severe rather than of mild diastolic hypertension. However, since we have encountered considerable overlapping, too much prognostic significance has not been ascribed to volume pulse wave contour changes of this variety. On the other hand, certain other alterations in the intrinsic digital volume fluctuations may be prognostically important, since on occasion they may reflect the development of diseases which not infrequently complicate hypertension. Thus a decrease in the normal slope inequality of the systolic and diastolic limbs, a blurring or disappearance of the dicrotic notch, and a reduction in the amplitude or a complete disappearance of the alpha waves may represent coexist

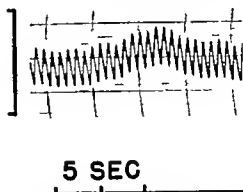


Fig. 2 Toetip plethysmogram in a patient with both hypertension and arteriosclerosis. Note the absence of the dicrotic notch, the inconspicuous alpha waves, and the loss in the normal slope inequality of the systolic and diastolic limbs.





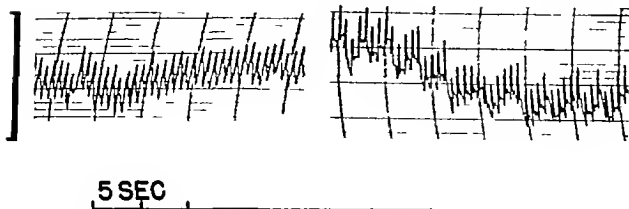


Fig. 5 Toetip plethysmograms from a hypertensive patient before and after nitroglycerine. Control tracing on the

left. Note that following nitroglycerine the primary change is manifested by a fall in the position of the diastolic notch.

ences of previous investigators which demonstrated that the administration of nitrites may be followed by vasodilatation resulting from a direct effect upon the smooth muscle of the smaller blood vessels suggested the use of nitroglycerine as a means of reducing vasomotor tone. Accordingly this drug was administered sublingually in doses ranging from 1/100 to 1/150 grain to 98 hypertensive patients. The plethysmographic changes which ensued could be classified into a number of broad categories: in one there was an increase in volume pulse amplitude and a fall in the position of the diastolic notch (Fig. 3) in another the amplitude increased but the pulse contour remained unchanged (Fig. 4) in a third a characteristic lowering in the location of the diastolic notch was observed (Fig. 5) but there was either no change or an actual decrease in the amplitude of the volume pulse in a fourth the volume pulse amplitude decreased and the diastolic notch fell (Fig. 6) and in the fifth no plethysmographic alterations were evident. These

distinctions are not absolute. For example the extent to which both the diastolic notch descends and the volume pulse amplitude increases may be slight or moderate or marked. Ordinarily an increase in the amplitude of the volume pulse deflections was accompanied by an increase in the frequency and in the amplitude of the alpha waves. Exceptions to this relationship were encountered and subsequent results indicated that from the prognostic viewpoint alterations in alpha waves were not as significant as were corresponding changes in the volume pulse waves.

Usually the plethysmographic patterns of corresponding digits in each individual were similar. On occasion they differed markedly in that the amplitude of the various intrinsic volume deflections both before and after vasodilatation were much greater on one side than on the other (Fig. 7). It is evident that differential plethysmographic patterns of this type indicate the existence of structural vascular disease. Such findings also demonstrate that

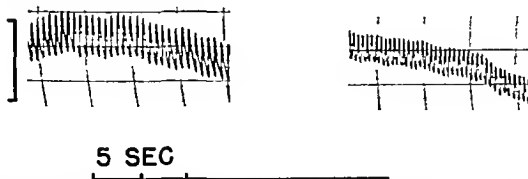


Fig. 6 Toetip plethysmograms from a hypertensive patient before and after nitroglycerine. Control tracing on the

left. Note that after nitroglycerine the volume pulse amplitude decreased while the diastolic notch fell to the baseline.

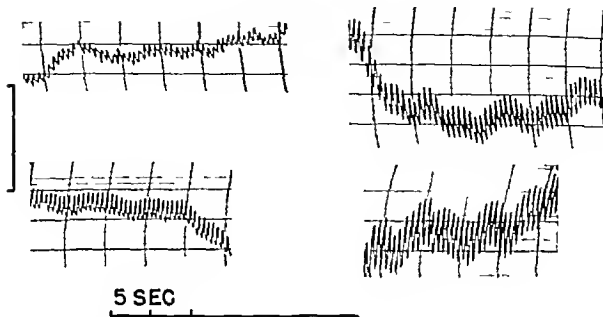


Fig. 7. Toeup plethysmograms from a hypertensive patient. Upper tracings from the left and right great toes be-

fore lower tracings from the same toes after nitroglycerine. Note the marked differences in both sets of tracings.

the rate at which the pathological alterations in the different vascular beds develop may vary considerably.

The change in the volume fluctuations of the digits which follow the administration of nitroglycerine has been employed as an index for estimating the functional occlusive as opposed to the structural occlusive component in each instance of hypertension. Since the functional integrity of a vascular bed may be measured by its ability to dilate the absence of any plethysmographic change after the administration of nitrites presumably indicates that fixed organic vascular disease is present. A decrease in the volume pulse amplitude even when coupled with a decline in the position of the diastolic notch is evidence that structural alterations in the blood vessels have developed. The reduced amplitude may be explained by assuming that a portion of the circulating blood volume has been diverted temporarily to relatively uninvolved areas in which the peripheral resistance has been reduced by pharmacologic vasodilatation. Conversely an increase in the volume pulse amplitude especially when accompanied by characteristic changes in the contour of the volume pulse and by increases in the amplitude of the alpha waves strongly suggests

the presence of vasospasm. The magnitude of these alterations will represent the relative importance of increased vasomotor tone in each instance of hypertension.

At this point it may be stated that prognostic usefulness of the plethysmographic method has been established by the operative results. The procedure was originally designed as a method of study of the finer circulatory dynamics in hypertension and not as a means of selecting patients for sympathectomy. It is only as a result of analyzing the plethysmographic data and contrasting these with changes in arterial pressure after sympathectomy that there is justification for the statement that the criteria which have been described may be regarded as an index of postoperative results. Hence the present report details only the studies of those hypertensive patients who underwent operation.<sup>1</sup> It is evident from this study that the presence of factors such as cardiac enlargement, electrocardiographic changes, severe grades of hypertensive retinopathy, urinary abnormalities and diminished renal function cannot by themselves be considered as absolute indicators of poor surgical results. Fur-

Detailed table of essential physical and laboratory data as found in Table I in reprints of this article.

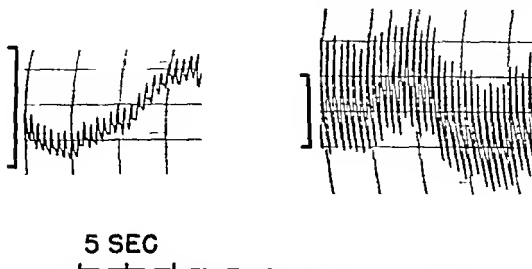


Fig 8 Toetip plethysmograms from the left great toe before and after left lumbodorsal sympathectomy. Tracing on the left before operation. Note the pronounced increase in amplitude which followed sympathectomy.

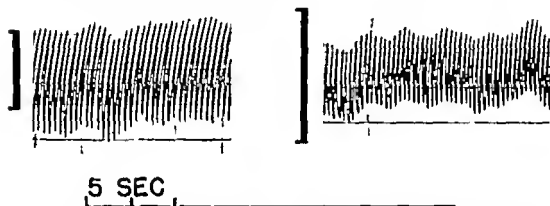


Fig 9 Toetip plethysmograms following lumbodorsal sympathectomy. Tracing on the left obtained before and that on the right obtained after nitroglycerine administration. Note the decrease in the volume pulse amplitude which followed the administration of nitroglycerine.

thermore the data suggest that an excellent therapeutic response may be expected in appropriately selected hypertensive patients who are more than 50 years old.

The sodium amylal test was performed in 23 of the 30 patients subjected to operation. The findings<sup>1</sup> have been compared with the plethysmographic changes after nitroglycerine and with the arterial pressure after sympathectomy. The contrast between the amylal test and the plethysmographic method is apparent. By the amylal test an accurate forecast was made in but 8 of the 23 patients, while by the plethysmographic method a correct result was prognosticated in 27 of the 30 patients. Plethysmography led to erroneous conclusions in 3 patients.

See Table II in reprint.

#### THE PLETHYSMOGRAM FOLLOWING SYMPATHECTOMY

After sympathectomy vascular tone is dependent upon local metabolic and environmental requirements and upon the concentration of circulating humoral vasoconstrictor and vasodilator substances (3). Variations in volume pulsations may therefore be quite pronounced unless observations are made under relatively constant conditions. Aside from this interruption of the sympathetic outflow to an extremity whose vascular bed has been in a state of increased tonus is followed by a maximal increase in the height of the volume pulse by a loss of vasoconstrictor reflexes and by a disappearance of the alpha waves (Fig 8). After attempted vasodilatation by nitroglycerine the volume pulse amplitude either remains

unchanged or it actually decreases (Fig 9). Conversely the failure to elicit these changes after sympathectomy is presumptive evidence that complete vascular denervation has not been attained. This observation is of importance since it may account for the poor operative results in patients deemed suitable for sympathectomy by the previously described plethysmographic criteria. As examples may be cited two of the patients in the series who although plethysmographically considered as excellent candidates developed no reduction in the level of the systemic arterial blood pressure after sympathectomy. The plethysmograms postoperatively were essentially similar to those obtained preoperatively in that large amplitude alpha waves persisted, nitroglycerine continued to induce a distinct increase in the volume pulse amplitude, and reflex vasoconstrictor activity could still be demonstrated. From a consideration of these facts it appears that the plethysmographic method may offer means of evaluating the extent and adequacy of operations on the sympathetic nervous system. Therapeutic implications are apparent.

Digital plethysmography has been of additional value in that by this method we have been able to demonstrate objectively the basis for the acroparaesthesias in the fingers which not infrequently follow sympathectomy. Fingertip tracings in these cases have revealed an increase in vasomotor tone as evidenced by the fact that the volume pulse amplitude postoperatively is reduced when compared with the amplitude preoperatively.

#### DISCUSSION

It is now generally believed that there are no structural vascular alterations until the later stages of essential hypertension are reached and that elevations in the level of the diastolic pressure are induced by increased vasoconstrictor activity mediated through humoral or neuropressor mechanisms. That the increase in total effective peripheral resistance may be primarily related to augmented vasomotor tone in selected areas of the systemic arteriolar bed is also generally accepted. Since bilateral sympathectomy aims at reducing the vasomotor tone of the splanchnic area and of the lower extremities, in theory at least its effectiveness

will be limited by the following factors, namely: that segments of the arteriolar bed other than the splanchnic area and the lower extremities are responsible for the increased peripheral resistance; that the increased resistance is induced by humoral rather than by neurogenic mechanisms; and that structural alterations have developed. A consideration of these facts enables one to understand why inferences based only upon a simple measure of the arterial pressure after the administration of the various pharmacologic agents which have been advocated so frequently lead to erroneous conclusions. For similar reasons the inherent fallacy of basing prognostications upon the presence or absence of retinal urinary electrocardiographic and roentgenological changes is apparent. While as a generalization it is true that the existence of such alterations is indicative of an advanced stage of hypertension, the results of our study demonstrate that each patient must be evaluated individually and that the occurrence of these organ changes is not incompatible with excellent operative results. By the same token the fact that a hypertensive patient is past the age of 50 years means that in all probability he has had an elevated blood pressure for a longer period than a younger patient and that the likelihood of generalized vascular changes has correspondingly increased. As with the other factors mentioned this concept is only valid in broad terms and the importance lies in exactly individualizing each patient. We are therefore forced to the conclusion that the indications for operation should be essentially clinical and that the reliance on the prognosis of operation can be placed on microplethysmographic examination.

At the present time there is no practical method that is available to evaluate the factor of splanchnic vasoconstriction but in contradistinction to the other procedures which have been previously advocated microplethysmography can offer accurate objective information concerning the vascular state of at least a portion of the arteriolar bed which is to be denervated by sympathectomy. As Goetz has emphasized digital plethysmography evaluates the "ultimate" circulation and although there can be no argument with the technique a logical and valid criticism of the procedure

may be based on the use of nitroglycerine, especially since the nitrites and sympathectomy induce vasodilatation by entirely different mechanisms. We are cognizant of this possible source of error, and are analyzing this problem by contrasting the plethysmographic changes following the use both of nitroglycerine and tetraethylammonium. The results of these experiments are to be presented in a future report.

#### SUMMARY AND CONCLUSIONS

1 A microplethysmographic method is described for selecting hypertensive patients who are to benefit from sympathectomy. This is based on the use of a new direct ink recording photoelectric microplethysmograph.

2 The procedure entails an analysis of the volume changes occurring in the phalanges before and after the attempted release of vasomotor tone by nitroglycerine.

3 It was demonstrated that one of five volume alterations follow the sublingual administration of nitroglycerine and that satisfactory operative results occur only in those patients who develop a pronounced increase in the volume pulse amplitude after nitrite ingestion. The simultaneous occurrence of an increase in the amplitude and in the frequency of the alpha waves is a good prognostic sign but the

absence of such changes does not preclude a significant postoperative reduction in the arterial pressure.

4 The plethysmographic method predicted the operative results correctly (whether favorable 20 patients or unfavorable 7 patients) in 27 of the 30 subjects. In contrast the sodium amytal test led to accurate conclusions in 8 of 23 patients.

5 The inherent fallacy of the amytal test and of the other criteria currently employed as indices of operability is discussed.

6 Aside from its usefulness as a means of selecting patients for operation, microplethysmography has the added value of being able to estimate the postoperative extent and completeness of sympathectomy.

7 A possible error in the procedure is mentioned. This depends upon the use of nitroglycerine as a vasodilator.

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# EFFECTS OF SUBLETHAL HEMORRHAGE IN NORMAL DOGS AND IN DOGS PREVIOUSLY TRANSFUSED WITH WHOLE BLOOD

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THE changes occurring in the circulating blood of man and animals following hemorrhage have been fairly well investigated. In an experimental investigation of hemorrhagic shock Price and his associates (12) have demonstrated what changes occur in the circulating blood of dogs following acute lethal hemorrhage. It is generally believed that following rapid severe hemorrhage there is a decrease in plasma protein concentration and in hemoglobin concentration proportional to the amount of fluid shifted into the blood stream. Elman (10) stated that after hemorrhage the most pronounced hemodilution occurred within the first hour and continued for 72 hours. Price reported (12) that following massive bleeding (34 c.c. per kgm.) there was an influx of fluid into the blood stream of 3.4 cubic centimeters per kilogram and an influx of red cells amounting to 3.8 cubic centimeters per kilogram within 5 to 6 hours. Although Price noted no increase in total circulating plasma protein mass following fatal hemorrhage in normal dogs, he found that after a single sublethal hemorrhage the total plasma protein mass returned to normal in 48 hours and plasma volume returned to normal in 24 hours. Elman (8) stated that following sublethal hemorrhage correction of the lost albumin fraction began in the first 6 hours and was still incomplete at 7 days. He noted also (9) that in fasting dogs which were bled rapidly and in which the blood was replaced with saline there was a drop of 20 to 22 per cent in protein concentration. This value did not change for 6 hours indicating that there was no rapid mechanism for the restoration of serum protein concentration. Cutting found that after the removal of

40 per cent of the blood of a rat the total protein mass returned to the original level in 12 hours. Calvin (4) stated that following subacute hemorrhage in a dog there was evidence of movement of fluid into the circulation within a few hours and that protein (primarily albumin) entered with this fluid. Beattie (5) concluded that within 2 hours of hemorrhage, in cats anesthetized with nembutal there was evidence of movement of plasma proteins into the blood stream.

Relatively little attention has been paid, however to the changes which occur in the circulating blood of animals following hemorrhage when those animals have been previously transfused with whole blood. Since preoperative transfusion of patients in anticipation of a sanguineous operative procedure is common practice it was thought that transfusion of experimental animals prior to rapid, sublethal hemorrhage, and comparison of the posthemorrhagic response to that of control dogs subjected to similar hemorrhage might shed some light on the efficacy of the practice. This paper is a report of an experimental study of that sort.

## METHODS AND CALCULATIONS

The first group of dogs were normal healthy animals with an average weight of  $17.6 \pm 1.3$  kilograms. This group of animals was used as controls.

They were anesthetized lightly with intravenous 5 per cent sodium pentobarbital solution and were prepared for the experiment by cannulating the carotid artery intubating the trachea, and exposing the femoral vein. Following a basal period of 1 to 2 hours, during which time preliminary determinations were made, the dogs were bled rapidly from the carotid artery. The effects of this bleeding were then studied for 5 hours.

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The second group the experimental animals consisted of normal healthy dogs averaging  $17.0 \pm 1.1$  kilograms. They were prepared in the same manner as the first group except that following the "basal" period they were transfused with well matched, citrated, whole blood which had been freshly drawn from healthy dogs. After transfusion studies were made for a period of 3 to 5 hours. The dogs were then bled rapidly from the carotid artery and the various determinations made hourly for 4 to 12 hours.

All determinations were made by means of standard methods and procedures which have been described more completely elsewhere (12, 14). In brief however the dye method (T 1824) with Price and Longmire's (13) modification of the Gibson and Evelyn technique was used for plasma volume determinations and the falling drop method of Barbour and Hamilton checked occasionally by Kjeldahl measurements was used for protein concentration determinations.

Statistical analysis consisted of computing the standard error of all means and of testing the significance of those means. When it was desired to show a significant difference between means the standard error of the difference between means was tested for significance.

## RESULTS

This study included 2 series of experiments. The first, a control study consisted of 6 normal dogs which were bled rapidly from the carotid artery and in which the posthemorrhagic response was studied for 5 hours. The bleeding required 3 to 5 minutes and averaged  $150 \pm 7$  cubic centimeters per kilogram.

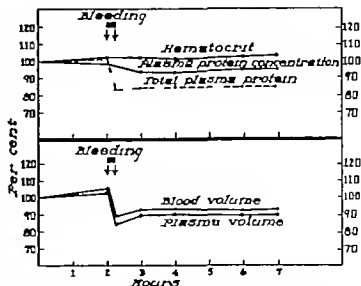


Fig. 1. Control study. Effects of rapid sublethal hemorrhage in normal dogs anesthetized with sodium pentobarbital. Mean values of 6 experiments.

The second series consisted of 10 dogs which were transfused before being bled. Five of these dogs were splenectomized in order to eliminate the factor of the expansile canine spleen and its consequent effects as an erythrocyte store. In general little difference was noted however between the splenectomized and nonsplenectomized dogs except in the response of the total hemoglobin mass after bleeding.

Each experiment in the second series consisted of 3 parts. First there was a 'basal' period prior to transfusion during which preliminary studies were made. These initial determinations made during the first  $1\frac{1}{2}$  to 2 hours, represent normal values for the animal and hereafter will be designated basal values. The second part of the experiment began with the start of the transfusion which required

TABLE I.—AVERAGE VALUES DETERMINED BEFORE AND AT HOURLY INTERVALS AFTER RAPID SUBLETHAL HEMORRHAGE IN NORMAL DOGS ANESTHETIZED WITH SODIUM PENTOBARBITAL

	"Basal"	Immediately before hemorrhage observed values	Immediately after hemorrhage expected values	hour after hemorrhage	hours after hemorrhage	4 hours after hemorrhage	5 hours after hemorrhage
Hematocrit	$43.8 \pm .1$	$43.4 \pm 1.8$		$43.1 \pm 1.9$	$42.5 \pm 2.3$	$43 \pm 1.7$	$44.0 \pm 2.3$
Circulating cell volume (c.c. per kgm.)	40.6	44.8	38.6	39.6	38.7	38.7	38.7
Plasma protein concentration (grams per cent)	$6.15 \pm .15$	$6.80 \pm .18$		$5.90 \pm .17$	$5.80 \pm .15$	$6.02 \pm .16$	$6.80 \pm .14$
Total plasma protein mass (grams per kgm.)	$83 \pm .17$	$84 \pm .1$	$33 \pm .3$	$40 \pm .18$	$41 \pm .7$	$40 \pm .10$	$41 \pm .30$
Plasma volume (per kgm.)	$45.5 \pm 1.4$	$47 \pm 1.6$	$38.4 \pm 1.3$	$41.0 \pm 1.8$	$43.5 \pm .8$	$40.7 \pm .$	$40.9 \pm .1$
Blood volume (c.c. per kgm.)	$55.1 \pm 1.3$	$62.0 \pm .8$	$77.0 \pm .7$	$80.6 \pm .9$	$80 \pm .5$	$79.4 \pm .4$	$79.6 \pm .4$



TABLE II.—AVERAGE VALUES OF THE CITRATED BLOOD USED FOR THE 10 TRANSFUSIONS

Amount of blood given per kgm. of recipient	$5.4 \pm .2$ c.
Amount of plasma given per kgm. of recipient	$1 \pm .3$ c.
Protein concentration	$8.86 \pm .09$ grams per cent
Hemoglobin concentration	$12.4 \pm .7$ grams per cent
Hematocrit	$43.7 \pm .8$
Amount of protein given per kgm. of recipient	$65 \pm .05$ gram
Amount of hemoglobin given per kgm. of recipient	$68 \pm .11$ grams

approximately 1 hour and terminated at the time of bleeding. The last value determined just before bleeding is referred to as the 'pre-hemorrhage' value and marked the beginning of the third or posthemorrhage portion of the experiment. After bleeding which required but 3 to 5 minutes and averaged  $16.4 \pm 1.2$  cubic centimeters per kilogram, determinations were made at hourly intervals until 4 hours or more had elapsed.

The term 'expected' value has been used to refer to those values calculated from the previous value minus the amount of blood plasma protein lost by hemorrhage. For example, the 'expected' blood volume after hemorrhage was calculated by subtracting from the 'prehemorrhage' blood volume the amount of blood taken from the carotid artery during the bleeding.

*Changes occurring after hemorrhage in normal dogs.* The changes which occurred in the cir-

culating blood of the 6 animals comprising the control series are given in Table I and a graphic representation of some of those changes is shown in Figure 1.

Following hemorrhage the dogs on the average gave little if any evidence of hemodilution (Fig. 1). The small changes which occurred were not significant. Variations in hemoglobin concentration paralleled those in hematocrit.

There was no significant alteration in circulating cell volume from that expected following hemorrhage. No change in relative red cell size could be detected.

All dogs showed some reduction of plasma protein concentration after hemorrhage. The average 4 to 5 per cent reduction was however not statistically significant.

Following hemorrhage, return of small amounts of plasma protein to the circulation could be detected in most of the control animals. Five of the 6 dogs showed a slight increase in total protein mass above that 'expected' after hemorrhage, but the average increase of 1.1 grams of protein (2.5 per cent of the entire protein mass) was not significant.

Blood volume showed an increase of 2.6 cubic centimeters per kilogram 4 hours after hemorrhage. This also was not a significant increase.

*Changes occurring during and immediately following transfusion.* Since the results of whole blood transfusions in normal dogs have been previously presented (14) the changes

TABLE III.—AVERAGE VALUES DETERMINED BEFORE TRANSFUSION, BEFORE HEMORRHAGE (3 TO 5 HOURS AFTER TRANSFUSION), AND AT HOURLY INTERVALS AFTER HEMORRHAGE OF 10 DOGS TRANSFUSED WITH CITRATED WHOLE BLOOD THEN BLED FROM CAROTID ARTERY

	"Blood"	"Pre-hemorrhage"	"Expected"	hours after hemorrhage	hours after hemorrhage	hours after hemorrhage
Hemoglobin (grams per cent)	$8 \pm .6$	$12 \pm$		$7.3 \pm .5$	$7 \pm .4$	$17 \pm .3$
Hematocrit	$46.5 \pm .6$	$56 \pm$		$43 \pm .6$	$43.7 \pm .5$	$53 \pm$
Total hemoglobin mass (grams per kgm.)	$2 \pm$	$8 \pm$	$6 \pm$	$6 \pm$	$3 \pm .5$	$2 \pm$
Protein concentration (grams per cent)	$8.8 \pm .06$	$14 \pm$		$6.79 \pm .06$	$8.0 \pm$	$8.7 \pm$
Total protein mass (grams per kgm.)	$3.04 \pm .17$	$6.4 \pm .09$	$2 \pm .9$	$3.1 \pm$	$3.3 \pm .03$	$4.5 \pm .04$
Plasma volume (cc. per kgm.)	$2 \pm$	$40 \pm$	$40 \pm$	$14 \pm$	$34 \pm$	$36 \pm .2$
Blood volume (cc. per kgm.)	$6 \pm .7$	$8 \pm$	$2 \pm$	$67 \pm$	$66 \pm$	$70 \pm$
Blood pressure (mm. of Hg.)	$14 \pm .8$	$90 \pm .7$		$30 \pm$	$30 \pm .5$	$18 \pm .3$
Pulse	$146 \pm$	$5 \pm .6$		$46 \pm .8$	$70 \pm$	$17 \pm .7$
Temperature	$38.8 \pm$	$41 \pm .7$		$38.8 \pm .7$	$38 \pm .7$	$41.5 \pm .6$



One hour following hemorrhage, total circulating protein mass (Fig. 2) increased above the expected value in 7 of the 10 dogs. In 2 experiments the influx of plasma protein into the blood stream was sufficient to return the plasma protein mass to its prehemorrhage value however the plasma protein increase observed in the other experiments was not great. Also the decrease in plasma protein below the expected value observed in 3 experiments was very slight. The average increase in plasma protein mass following hemorrhage was not significant.

An increase in plasma volume over and above the expected volume occurred in 9 of the 10 dogs 1 hour after hemorrhage. Average increase 1 hour after hemorrhage was 43 cubic centimeters per kilogram or 9 per cent above the expected plasma volume. Four hours after hemorrhage plasma volume was increased 59 cubic centimeters per kilogram or 13 per cent above the expected volume. These changes are illustrated in Figure 3. In 2 experiments plasma volume was increased above the prehemorrhage value, thus returning to the circulation an amount of fluid more than equal to the volume of plasma lost during hemorrhage. This average increase in plasma volume was statistically significant.

One hour and 4 hours after hemorrhage 6 of the 10 dogs showed an increase in blood volume above the expected volume. In 1 experiment blood volume returned to the prehemorrhage level at 4 hours. In those animals which showed a decrease in blood volume below the expected value there was no instance in which the decrease exceeded 5 per cent. In fact, most of these animals showed only a very slight decrease. The average increase of 65 cubic centimeters per kilogram at 4 hours (Fig. 2) was not significant.

During hemorrhage blood pressure fell precipitously from an average 150 millimeters of mercury to 50 to 60 millimeters of mercury. Recovery was rapid, however and usually blood pressure returned to within range (i.e. within 1 standard deviation) of the pretransfusion value in 15 minutes.

Following hemorrhage, there was usually a tendency for the pulse rate to increase but not enough to be considered significant.

There was a steady rise in temperature throughout the experiments. An average increase of 1.5 degrees from the start of the experiment to the time of hemorrhage was noted, and a further rise of 1.3 degrees from the time of hemorrhage to the end of the experiment was observed.

Respiratory rate, respiratory volume, and oxygen uptake were determined in 3 animals. No significant changes were noted in any of these values following hemorrhage.

#### DISCUSSION

The most striking change occurring in the circulating blood following hemorrhage was prompt hemodilution of greater or less degree due to influx of fluid into the circulation (Figs. 1 and 3). Although in the control animals some fluid entered the circulation after hemorrhage, it was not in significant amounts in the dogs that had been transfused just before hemorrhage however significant amounts of fluid did enter the circulation. A volume of fluid equivalent to 9 per cent of the original plasma volume was added to the circulation within the first hour on the average and by the end of 4 hours a volume of fluid equivalent to 13 per cent of the original plasma volume had entered the circulation. In the matter of fluid shifts therefore there appears to be a distinct difference between the normal dogs and those that had been transfused just before hemorrhage. However the size of these fluid translocations varied considerably and it is possible that these shifts depended more on the status of body hydration before the experiment than on the amount of blood added by transfusion. Although most of the fluid entered the circulation during the first hour in several experiments fluid continued to enter the circulation until 4 hours after hemorrhage.

In both series of experiments this influx of fluid following hemorrhage was sufficient to be reflected as changes in hematocrit, hemoglobin and plasma protein concentration. These values showed an immediate decrease during the first hour. The influx of red blood cells, which was about 4 per cent of the original total mass in both series, was sufficient to forestall further apparent hemodilution after the first hour.

# THE NATURE OF POSTOPERATIVE HYPOPROTEINEMIA IN PATIENTS WITH GASTROINTESTINAL CANCER

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PATIENTS with gastrointestinal cancer frequently present variable degrees of emaciation and cachexia. Because of the high incidence and great mortality from gastrointestinal cancer a study was instituted to investigate some of the metabolic abnormalities that might exist. This report deals with the incidence and degree of hypoproteinemia in patients with gastrointestinal cancer and emphasizes the effect of surgery upon certain phases of nitrogen metabolism

## POSTOPERATIVE PLASMA PROTEIN CONCENTRATION IN PATIENTS WITH GASTRIC CANCER

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The cause of hypoproteinemia is not entirely clear. Several possibilities present themselves, namely: (1) deficient diets; (2) repeated hemorrhage; (3) a defect in the absorption of amino acid; (4) increased catabolism of the protein; or (5) some metabolic abnormality which prevents the synthesis of serum proteins.

*Dietary deficiency.* In an attempt to ascertain the role played by a deficient dietary intake in the production of hypoproteinemia the patients were divided into two groups

according to the degree of dietary deficiency. The mean serum protein level and the standard deviation were computed for each group.

The distribution of the serum protein determinations was plotted against variations in diet to show what effect if any dietary intake has on the serum protein level. Analysis of the data reveals no statistically significant difference between the means of the different groups which gave evidence of dietary deficiency. All protein values were significantly lower than normal (Chart 3).

It thus becomes apparent that variations in the degree and duration of dietary deficiency do not contribute by themselves significantly to the incidence and degree of hypoproteinemia in patients with gastric cancer.

*Relationship of bleeding to hypoproteinemia.* Bleeding is an important factor which might be responsible for an abnormal erythron or a low plasma protein concentration. In this series a patient was considered to present evidence of blood loss if he fulfilled any one of the following criteria: (a) history of blood loss (melena, hematemesis, etc.) within 6 months previous to his admission; (b) presence of blood in the stools after 3 days upon a meat-free diet; (c) presence of occult blood within the gastric contents.

Of the 100 patients studied evidence of blood loss was observed in 42 cases (42%). The arithmetical mean of the serum protein in this group is 6.1 grams per cent. In the other 58 per cent of the series that did not present any evidence of blood loss the arithmetical mean of the serum protein concentration is 6.1 grams per cent (8). The difference between these two groups is not statistically significant; hence it can be concluded that bleeding does not contribute significantly to the low level of the serum protein in this series of patients.

*Abnormalities in amino acid metabolism.* The possibility presents itself that amino acids are not absorbed properly or that after they are

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control animals and the animals previously transfused showed considerable variation in response to acute plasma protein loss. As has been stated some of the dogs quickly added as much as 10 to 11 grams of protein to the circulation others none at all. The average response by control and previously transfused dogs was not significantly different.

It would appear that rapid influx of plasma protein to the blood stream following bleeding depends upon at least 3 factors (1) acute need (2) availability of protein in stores and (3) the original concentration of protein in the plasma. Since the acute need for protein was standardized in all our animals and since there was no consistent relationship in our experiments between original plasma concentration and the amount of protein returned to the plasma variations in response are attributed in a large part to variations in availability of suitable stored plasma protein. Inasmuch as there was little difference in response to hemorrhage between our control and transfused dogs, it follows that the transfusions given prior to bleeding probably did not add protein to protein stores in such a form that it could be called upon in case of acute need.

#### CONCLUSIONS

1 Results of rapid sublethal hemorrhage in normal dogs and in dogs previously transfused with whole blood have been presented.

2 A blood transfusion given a few hours before sublethal hemorrhage in normal dogs did little to influence the posthemorrhagic response except to supply an extra number of red blood cells and possibly a small fluid reserve.

3 Evidence is presented to support the existence of plasma protein stores.

4 The protein that was given with a blood transfusion to a normal dog quickly left the circulation. There is reason to believe that part of it at least entered plasma protein depots.

5 When a previously transfused animal was subjected to an acute sublethal hemorrhage as a rule only a small portion of the needed plasma protein was added promptly to the circulation following the hemorrhage.

6 It seems probable therefore that the plasma protein which disappeared from the circulation following transfusion of normal dogs did not in most cases enter protein stores in such a form as to be available for immediate recall to the circulation following rapid sublethal hemorrhage.

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# THE NATURE OF POSTOPERATIVE HYPOPROTEINEMIA IN PATIENTS WITH GASTROINTESTINAL CANCER

IRVING M ARIEL, M D., Minneapolis, Minnesota

**P**ATIENTS with gastrointestinal cancer frequently present variable degrees of emaciation and cachexia. Because of the high incidence and great mortality from gastrointestinal cancer, a study was instituted to investigate some of the metabolic abnormalities that might exist. This report deals with the incidence and degree of hypoproteinemia in patients with gastrointestinal cancer and emphasizes the effect of surgery upon certain phases of nitrogen metabolism

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The cause of hypoproteinemia is not entirely clear. Several possibilities present themselves namely (1) deficient diets (2) repeated hemorrhage (3) a defect in the absorption of amino acids (4) increased catabolism of the protein or (5) some metabolic abnormality which prevents the synthesis of serum proteins.

**Dietary deficiency** In an attempt to ascertain the role played by a deficient dietary intake in the production of hypoproteinemia the patients were divided into five groups

according to the degree of dietary deficiency. The mean serum protein level and the standard deviation were computed for each group.

The distribution of the serum protein determinations was plotted against variations in diet to show what effect, if any, dietary intake has on the serum protein level. Analysis of the data reveals no statistically significant difference between the means of the different groups which gave evidence of dietary deficiency. All protein values were significantly lower than normal (Chart 3).

It thus becomes apparent that variations in the degree and duration of dietary deficiency do not contribute by themselves significantly to the incidence and degree of hypoproteinemia in patients with gastric cancer.

**Relationship of bleeding to hypoproteinemia** Bleeding is an important factor which might be responsible for an abnormal erythron or a low plasma protein concentration. In this series a patient was considered to present evidence of blood loss if he fulfilled any one of the following criteria: (a) history of blood loss (melena, hematemesis, etc.) within 6 months previous to his admission; (b) presence of blood in the stools after 3 days upon a meat free diet; (c) presence of occult blood within the gastric contents.

Of the 100 patients studied, evidence of blood loss was observed in 42 cases (42%). The arithmetical mean of the serum protein in this group is 6.1 grams per cent. In the other 58 per cent of the series that did not present any evidence of blood loss the arithmetical mean of the serum protein concentration is 6.2 grams per cent (8). The difference between these two groups is not statistically significant; hence it can be concluded that bleeding does not contribute significantly to the low level of the serum protein in this series of patients.

**Abnormalities in amino acid metabolism** The possibility presents itself that amino acids are not absorbed properly or that after they are

Parts of this study were performed at Memorial Hospital, New York, New York.

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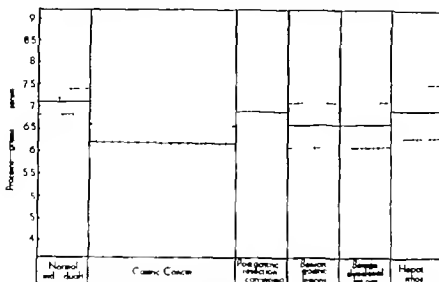


Chart 1. A scatter diagram of total protein concentration per 100 cubic centimeters of serum expressed according to groups with various diseases and one normal control group. The heavy horizontal line represents the mean of each group and the area between the broken lines represents the values between the plus and minus standard deviations from the mean.

absorbed they can not be utilized in a normal manner. This has been substantiated. The ingestion of 25 grams of aminoacetic acid revealed that in 6 controlled subjects the maximum absorption of the compound occurred within the first hour. In contrast to this, in 6 patients with gastrointestinal cancer the peak of absorption was considerably delayed in all. The delayed absorption of the amino

acid apparently does not depend merely on the presence of organic gastrointestinal disease for a normal rate of absorption was noted in one patient with atrophic gastritis, in one patient with multiple gastric ulcers, and also one patient with gastric Boeck's sarcoid. These data indicate that the abnormality of absorption may be intimately linked with the presence of cancer (9) (Chart 4). After resection of the cancer improvement of absorption occurs (Chart 5).

The following experiments indicate that in addition to the defective absorption of the amino acid there exists also abnormalities of their metabolism.

a. The ingestion of 25 grams of aminoacetic acid raised the average concentration of serum amino acids in normal individuals by 2.9 milligrams per 100 cubic centimeters. The average increase in the serum of 6 patients with gastrointestinal cancer was 6.6 milligrams (Chart 4). This high level of amino acids in the serum of patients given aminoacetic acid orally has been demonstrated to indicate inability of the liver to utilize that compound at a normal rate (9).

b. Following the intravenous administration of 75 milligrams per kilogram body weight

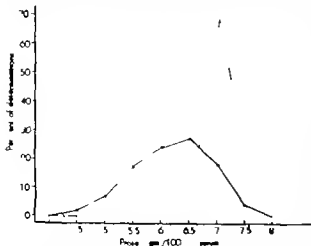


Chart 2. Frequency polygon of total serum protein concentration of patients with gastric cancer compared with normal individuals. — gastric cancer — hepatic cancer

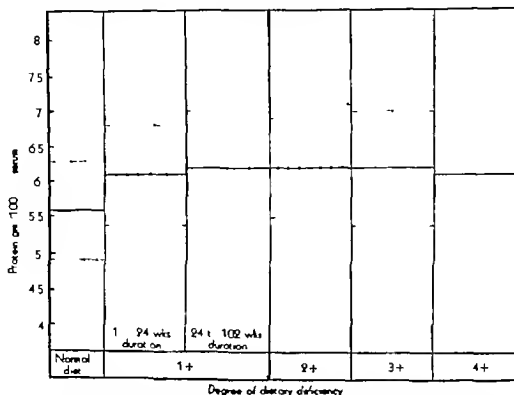


Chart 3 A scatter diagram of total protein concentration per 100 cubic centimeters of serum in patients with gastric cancer referred to degrees of dietary deficiency. The heavy unbroken line represents the mean of each group and the area between the broken lines represents the values between the plus and minus standard deviations from the mean.

aminoacetic acid the analyses of the urinary output of creatine and creatinine in both normal controls and patients with gastrointestinal cancer reveals a marked increase in the amount of creatine and creatinine excreted by 9 normal individuals and 7 patients with benign gastrointestinal disease. The average increase in the normal group was 53.5 milligrams of creatine and 70 milligrams of creatinine and for the 7 patients with benign gastrointestinal lesions, 27.5 milligrams of creatine and 68.5 milligrams of creatinine.

In sharp contrast to these findings there was no increased creatine or creatinine in 19 patients with gastrointestinal cancer (2). This fact suggests that glycine which is the precursor for the formation of creatine so necessary for muscle metabolism is not utilized in its normal manner. The muscular weakness noted so frequently in patients with gastrointestinal cancer possibly could be the result of inability of these patients properly to synthesize creatine from glycine.

**Hepatic dysfunction.** The hypoproteinemia might conceivably be a manifestation of

hepatic dysfunction. Since it has been demonstrated that patients with gastrointestinal cancer suffer a high incidence of hepatic dysfunction (3) a comparison was made of the plasma protein concentration of 100 patients with gastrointestinal cancer and of 20 patients with hepatic cirrhosis. The data demonstrate that the degree of plasma protein depletion in patients with gastric cancer was far more severe than in those with hepatic cirrhosis (Chart 6). The albumin protein was the fraction that was depleted always (Chart 7).

**Protein catabolism.** Studies of the fecal nitrogen output of patients with gastrointestinal cancer revealed no dissimilarity to other groups of patients. The average fecal output is approximately 1 gram of nitrogen per day. Furthermore the urinary nitrogen of these patients while at rest is not in excess of that of control groups of persons (8). These data demonstrate that there is no increased catabolism of proteins to account for the depleted state.

The data thus far presented demonstrate that patients with gastrointestinal cancer suf-



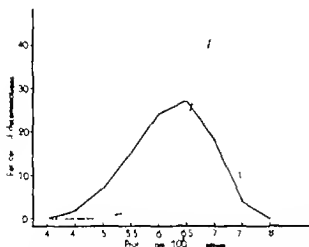


Chart 6 Frequency polygon of total serum protein concentration of patients with gastric cancer compared with patients with hepatic cirrhosis. — gastric cancer — hepatic cancer

who were submitted to surgical procedures similar to those to which were subjected the patients with gastrointestinal cancer. The results obtained in the patients with non-neoplastic gastrointestinal disease form an interesting contrast to those of the patients with cancer.

The preoperative concentration of serum protein in the patients with benign gastrointestinal disease ranged from 5.9 to 7.1 grams, and averaged 6.54 grams per cent.

When these individuals were subjected to surgery their serum protein levels fell in 6 instances from 0.1 to 0.3 gram, average 0.18

gram per cent. In one, no change in the serum protein concentration was noted, and in the remainder these concentrations increased by from 0.1 to 0.4 gram per cent in that period. However, although no significant decrease in the concentrations of serum protein was observed in these individuals, nevertheless, they excreted from 5.3 to 13.8 grams of urinary nitrogen per day (average 8.90 grams per day) during the first five postoperative days. It is to be noted that these amounts of urinary nitrogen are the same as those excreted by the patients with gastrointestinal cancer who did develop hypoproteinemia. As in the latter group, no correlation could be made between the postoperative levels of serum protein and the amounts of urinary nitrogen excreted.

The second control group of patients investigated were 9 women subjected to gynecologic surgery. It was believed that this study would provide data of the effects on protein catabolism of intra abdominal operations other than those on the gastrointestinal tract. The preoperative concentrations of serum protein of these 9 patients ranged from 5.9 to 7.6 grams and averaged 6.61 grams per cent. Of these 4 had abnormally low levels. Within 5 days after operation the concentration of serum protein fell in 5 from 0.1 to 1.1 grams. The average decrease of these 5 patients was 0.38 gram per cent. The concentration of serum protein did not change in 1 instance, and increased from 0.1 to 0.2 gram per cent in the remaining 3 patients.

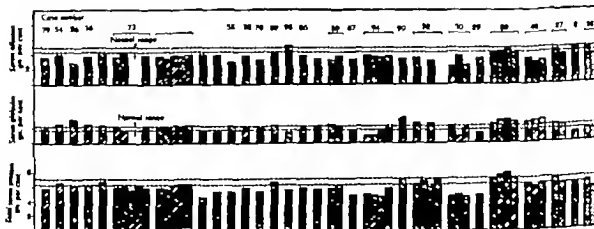


Chart 7 The albumin and globulin concentrations in the serum of patients with gastric cancer

During the first 5 postoperative days the average daily amounts of nitrogen excreted by the patients with gynecologic disorders ranged from 3.24 to 10.35 grams and averaged 7.04 grams. As in the other 2 groups of patients who were studied, no correlation could be made between the amounts of urinary nitrogen which were excreted and the amounts by which the serum protein concentrations decreased.

It is of considerable importance to note however that although the 2 control groups of patients lost an average of 7.04 and 8.90 grams of urinary nitrogen per day after operation the patients with gastrointestinal cancer excreted a comparable quantity of nitrogen, 8.96 grams per day. The average maximum change in the concentration of serum protein in the patients with gastrointestinal cancer, however, was 0.81 gram per cent, whereas the concentration of serum protein in the 2 control groups decreased only 0.18 and 0.38 gram per cent.

The maximum serum protein drop occurred on the fourth postoperative day. Despite rigorous attempts at re-establishing a normal plasma protein level the plasma proteins remained low during the 29 day period following

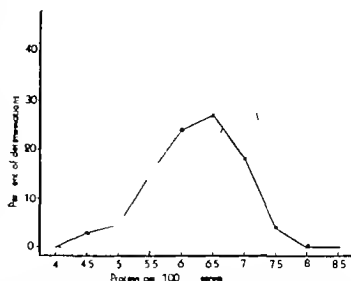


Chart 8. Frequency polygon of total serum protein concentration of patients with gastric cancer compared with a group of patients in whom the cancerous stomach previously had been resected. — gastric cancer — hepatic cancer

surgery that the patients were studied (Chart 10)

The findings indicate that not only are the concentrations of serum protein in patients with gastrointestinal cancer low before operation but those levels now have been found to fall to still further abnormally low limits after operation. There is now reason to believe that

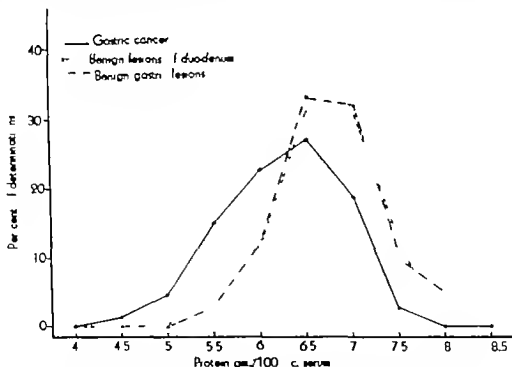


Chart 9. Frequency polygon of total serum protein concentration of patients with gastric lesions and of patients with benign duodenal lesions.

TABLE I—EFFECT OF OPERATION UPON THE SERUM PROTEIN CONCENTRATION IN PATIENTS WITH DIFFERENT DISEASE PROCESSES AND THEIR EXCRETION OF URINARY NITROGEN

Patient's ill	Number of patients	Preoperative serum protein concentration gm. per cent	Average percentage drop in serum protein level during first 3 postoperative days—gm. per cent	Per cent of patients whose serum protein dropped after operation	Average daily urinary nitrogen during first 3 days postoperative gm.
Gastrointestinal cancer	47	6.3	3	34	8.96
Non-neoplastic diseases of the gastrointestinal tract	6	6.24	13	67	8.90
Gynecological disorder	9	6.6	25	11	7.81

the hypoproteinemic state developed after operation chiefly is responsible for the high incidence among these patients of wound disruption, disturbed electrolyte equilibrium (6) adynamic ileus and gastrointestinal and peripheral edema. Because of the development of these serious postoperative complications the existence of hypoproteinemia in patients with gastrointestinal cancer becomes of considerable importance.

Although both the patients with gastrointestinal cancer and those of the 2 groups used

as controls all excreted comparably equal amounts of urinary nitrogen after operation, only the first group of individuals sustained considerable reductions of their serum protein levels. The explanation for this observation probably is that (a) the tissue protein stores of patients with cancer of the gastrointestinal tract are depleted and therefore cannot restore the serum protein concentrations to their preoperative levels and (b) the ability of these individuals to fabricate serum protein is impaired.

TABLE II—THE CHEMICAL COMPOSITION OF LIVERS OF PATIENTS WITH CANCER OF THE GASTROINTESTINAL TRACT

Patient	Histologic appearance of the liver	Glycerin, gm. per cent	Total lipid, gm. per cent	Total protein, gm. per cent	Albumin, gm. per cent	"Globulin, gm. per cent	Serum protein, gm. per cent
B. S.	Normal		5				
F. B.	Normal	8.6	22				
A. B.	Moderate fatty infiltration			24	3.9	10.8	8.6
H. D.	Normal			6	5.2	10.9	7.5
P. F.	Normal		14.5	7	5		7
T. O.	Normal	45	14	3	3.3	10	6.5
S. H.	Normal	8	5.5				
A. V.	Normal						
W. J.	Normal		8.11	5.8	5.3	10.5	5.7
M. F.	Normal		97	19	6.45	7.97	5.7
L. R.	Normal		9	7.85	6	13	7
L. B.	Normal		6.9	16	5.8	10.4	
J. B.	Normal	1.8	24				
J. T.	Normal	8.3	8	17.8	3	14.6	6.7
J. T.	Moderate fatty infiltration		20				
V. T.	Normal	3			4	8.5	7.4
B. W.	Normal		33	16.8	5	5	5
K. Y.	Normal	3	8.9	6			5
Average		21	7.43	16.77	3.10	10	

(Courtesy of *Annals of Internal Medicine*—9).

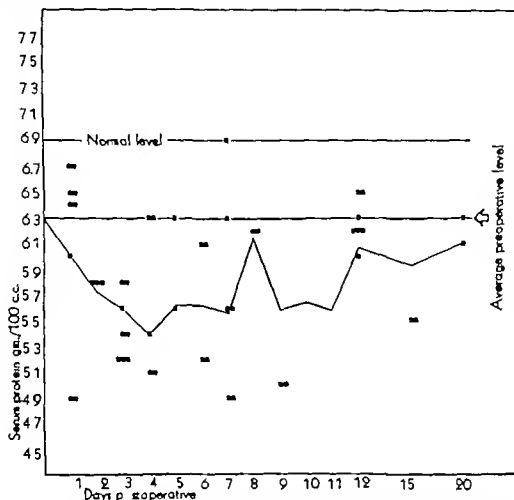


Chart 10. Postoperative serum protein alterations in patients with gastric cancer. The small black squares represent individual determinations. The curve demonstrates the average daily postoperative fluctuation of the serum protein concentration.

#### RELATIONSHIP OF LIVER PROTEIN TO PLASMA PROTEIN CONCENTRATION

From evidence recently presented a decreased concentration of serum protein has been found associated with depletion of tissue proteins (12).

It has been observed that the livers of fasted animals are depleted of proteins with great rapidity (4) and that when animals are maintained on high protein diets all the protein fractions of their livers increase (11). These observations suggest that the liver may store proteins and that those stores might be abnormally reduced in the hypoproteinemic patients.

To note if any correlation existed between the protein concentration of the liver and the depleted plasma protein content, chemical analyses of the livers of 12 patients with gastro-

intestinal cancer were performed. The data are summarized in Table II.

The concentrations of proteins in the normal human liver are not known and so not available for purposes of comparison. One may hazard perhaps a comparison of the values obtained with those of animal liver tissue. The total protein in the liver of the rat has been found to average 15.5 grams the albumin 2.1 grams and the globulin 13.4 grams per cent. In the dog liver the average total protein content has been found to be 17.5 grams per cent.

The total hepatic protein in 12 patients with gastrointestinal cancer ranged from 12.9 to 17.95 and averaged 16.17 grams per cent. The albumin contents averaged 5.10 grams and varied from 3.2 to 8.05 grams per cent, and the globulin averaged 11.0 and ranged

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Gastrointestinal cancer	7	6	5	84	2.96
Non neoplastic disease of the gastrointestinal tract		5	1.8	67	2.90
Gynecologic disorder	9	5.6	1.9	55	1.94

the hypoproteinemic state developed after operation chiefly is responsible for the high incidence among these patients of wound disruption, disturbed electrolyte equilibrium (6) adynamic ileus and gastrointestinal and peripheral edema. Because of the development of these serious postoperative complications the existence of hypoproteinemia in patients with gastrointestinal cancer becomes of considerable importance.

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Patient	Histologic appearance of the liver	Glycerin, gm per cent	Total lipid, gm per cent	Total neutral, gm per cent	Urea, gm per cent	Globulin, gm per cent	Serum protein, gm per cent
S B	Normal						
F B	Normal						
A B	Moderate fatty infiltration	9				8	6.6
H D	Normal					10	7.3
P F	Normal		8		5		7
T G	Normal				3.2	10	6.2
S H	Normal	6	1.3				
A H	Normal						
W J	Normal		9.1	1.8	5.5	10.3	8.1
M P	Normal		17	16	11	7.07	8.7
L R	Normal		9	9	6	1.5	7
L S	Normal			16	5.8		
J B	Normal	5.8					
J T	Normal	8	14.8	7.8	3	6	6.7
J T	Moderate fatty infiltration		19				
V T	Normal	3	4		4	8.3	7
B W	Normal		25	16.8	6.2	5	6
E Y	Normal	7.3	16.6	5	4		6
Average		6.1	17.45	17	5.30	10.1	

(Courtesy of Annals of Internal Medicine—1)

TABLE I.—RESULTS OF SUBCUTANEOUS ADMINISTRATION OF BETA METHYLCHOLINE URETHANE IN POSTOPERATIVE URINARY RETENTION

Type of operation	Cases	Success	Partial success	Failure
Culporrhaphy	8		1	
Hemorrhoidectomy		7		1
Pelvic colostomy	3	3	0	
Upper abdominal colostomy	4	1		
Hemiorrhaphy	10	7		1
Abdominoperineal resection	1		1	
Upper urinary tract procedures	1	1		
Lebectomy and pyelostomy	4	3		
Lithotomy, strychnine, and craniotomy	0	2		
Cystoscopy	6	3		1
Appendectomy	13	0	3	3
Totals	76	46 (60%)	9 (12%)	21 (28%)
Male	43	3 (7%)	6 (14%)	1 (2%)
Female	33	43 (13%)	3 (9%)	6 (18%)

The ability to control fully the side effects of beta methylcholine urethane by the administration of atropine (5) makes it a more desirable drug than other choline esters. Starr and Ferguson (11) have given very complete data concerning the drug and its action in various normal and abnormal conditions.

The drug was given orally to the first group of patients in doses ranging from 4 milligrams every 4 hours up to 10 milligrams every 30 minutes for three doses as indicated by individual response. The results were poor and have not been included in this report. Subcutaneous administration has been much more effective and the drug is now given exclusively by this route. The most efficient results are obtained by giving 5 milligram doses at 30 minute intervals for three injections. If the patient voids satisfactorily after any one of the three administrations the drug is discontinued. The patient is catheterized if the third 5 milligram dose does not produce urination and then the drug is repeated as indicated later. We observed each case of the recorded group continuously throughout each procedure. The drug is probably too potent for safe

administration by the intravenous or intramuscular route in the treatment of postoperative urinary retention.

## RESULTS

We have recorded the results obtained in 76 consecutive unselected cases of postoperative urinary retention in which the drug was administered subcutaneously as outlined herein. Other methods of treatment had been tried without success in all except 12 patients and the time interval following the operative procedure varied from 6 hours to the eighth postoperative day. Dosages as large as 10 milligrams every 30 minutes for three injections were given subcutaneously in some of the earlier patients but in some instances the side actions of the drug were rather uncomfortable and the clinical results were only slightly more favorable. Since accumulating the data recorded in Tables I, II, and III we have administered the drug in about 150 additional cases with comparable results. There are 43 male and 33 female patients in the detailed recorded groups.

Tables I and II list the patients as to the type of operative procedure performed previous to the complication of postoperative retention and group the cases in three categories according to the results. These latter include successes, partial successes, and failures.

None of the patients classified as the successful group had to be catheterized. Forty-six patients voided spontaneously after subcutaneous administration of 5 milligrams of beta methylcholine urethane repeated at 30 minute intervals for three times when necessary. Seventeen of the 46 patients voided after being given 5 milligrams of the drug and in the remaining 29 it had to be repeated once or twice. The drug was routinely repeated if the bladder could be percussed or if the patient remained uncomfortable because of bladder distention following the first or second dose. The number of successes was higher in the male group.

In the patients classified as partially successful one series of beta methylcholine urethane was given as outlined previously and the individual did not void. The patient was then catheterized. Eight to 10 hours later the pro-

# THE USE OF BETA-METHYLCHOLINE URETHANE IN POSTOPERATIVE URINARY RETENTION

FRED K. GARVEY M.D., F.A.C.S., MEDFORD C. BOWMAN M.D. and  
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CONSIDERABLE search has been made for an effective drug to use for the treatment of postoperative urinary retention. Time honored methods are unreliable and most of the drugs which have been used have proved inadequate. We have found beta methylcholine urethane beneficial in a large percentage of these cases although it is not a final solution to the problem.

Postoperative urinary retention is that condition occurring following an operation in which the patient cannot void despite a full bladder normal kidney function and the absence of any organic obstruction. Normally the urinary bladder fills passively and empties under voluntary control. It is partly under voluntary control and is richly supplied by three sets of nerves. The sympathetic nerve supply is through the presacral and hypogastric nerves the stimulation of which relaxes the bladder wall and contracts the internal sphincter. The parasympathetic nerve supply is by way of the nervi erigentes upon stimulation of which relaxation of the external sphincter and contraction of the detrusor result. The pudendal nerve produces voluntary control of the external sphincter muscle and other perineal accessory muscles of urination. The desire to void depends upon intravesical pressure and not necessarily on the amount of urine present in the bladder. The average male bladder capacity is about 300 cubic centimeters and the female bladder capacity slightly less. The desire to void arises with a urinary bladder volume of 130 to 150 cubic centimeters. Contraction of the detrusor muscle, which constitutes the entire bladder musculature and the relaxation of the sphincters bring about emptying of the bladder. The

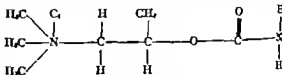
trigonal muscle shortens and helps open the sphincters.

## MATERIAL AND METHODS

Since the pioneer work of Dale, in 1914, it has been known that drugs belonging to the choline series mimic the effects produced by stimulation of the parasympathetic nervous system. Dale introduced the term 'parasympathomimetic' to describe these properties of choline derivatives. It has also been observed that atropine annuls the parasympathetic effects of choline derivatives (10).

Acetyl-beta methylcholine (methylol) (2, 3, 4, 7) and carbaminoyl-choline (doryl) (6, 9) have been the most widely used choline derivatives for their effects on the urinary bladder. Methylol is not stable and is quickly destroyed by the body fluids. Doryl has been found to be stable but possesses a very strong nicotinic action. We have had relatively little clinical experience with either of these drugs.

Carbaminoyl-beta methylcholine chloride (beta methylcholine urethane) was synthesized by Major in 1935 at the suggestion of Simonart (8). The empirical formula is  $C_{11}H_{20}N_2O_2Cl$  and the structural formula is



The pertinent quantitative solubilities are 1 gram in 0.6 cubic centimeter of water at room temperature and 1 gram in 12.5 cubic centimeters of 95 per cent ethanol at room temperature. The aqueous solution is very stable. The therapeutic and toxic effects of this drug are considerably less than those with doryl. This drug at present appears to be the most promising of the choline derivatives in the treatment of functional urinary retention.

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TABLE I.—RESULTS OF SUBCUTANEOUS ADMINISTRATION OF BETA METHYLCHOLINE URETHANE IN POSTOPERATIVE URINARY RETENTION

Type of operation	Cases	Success	Partial success	Failure
Colporrhaphy	8		5	
Hemorrhoidectomy		7		
Pelvic colostomy	3	3		
Upper abdominal colostomy	4			
Hysterorhaphy		7		
Abdominoperineal resection				
Upper urinary tract procedures	3	3		
Lobectomy and panprosectomy	4	3		
Lumpectomy, ah myelogram, and craniotomy	9	8		
Cystoscopy	6	3		
Appendectomy	5	0	3	2
Totals	76	45 (60%)	19 (25%)	12 (15%)
Male	43	31 (72%)	10 (23%)	12 (28%)
Female	33	14 (42%)	9 (27%)	10 (31%)

The ability to control fully the side effects of beta methylcholine urethane by the administration of atropine (5) makes it a more desirable drug than other choline esters. Starr and Ferguson (11) have given very complete data concerning the drug and its action in various normal and abnormal conditions.

The drug was given orally to the first group of patients in doses ranging from 4 milligrams every 4 hours up to 10 milligrams every 30 minutes for three doses as indicated by individual response. The results were poor and have not been included in this report. Subcutaneous administration has been much more effective and the drug is now given exclusively by this route. The most efficient results are obtained by giving 5 milligram doses at 30 minute intervals for three injections. If the patient voids satisfactorily after any one of the three administrations the drug is discontinued. The patient is catheterized if the third 5 milligram dose does not produce urination and then the drug is repeated as indicated later. We observed each case of the recorded group continuously throughout each procedure. The drug is probably too potent for safe

administration by the intravenous or intramuscular route in the treatment of postoperative urinary retention.

## RESULTS

We have recorded the results obtained in 76 consecutive unselected cases of postoperative urinary retention in which the drug was administered subcutaneously as outlined herein. Other methods of treatment had been tried without success in all except 12 patients and the time interval following the operative procedure varied from 6 hours to the eighth postoperative day. Dosages as large as 10 milligrams every 30 minutes for three injections were given subcutaneously in some of the earlier patients but in some instances the side actions of the drug were rather uncomfortable and the clinical results were only slightly more favorable. Since accumulating the data recorded in Tables I, II, and III, we have administered the drug in about 150 additional cases with comparable results. There are 43 male and 33 female patients in the detailed recorded groups.

Tables I and II list the patients as to the type of operative procedure performed previous to the complication of postoperative retention and group the cases in three categories according to the results. These latter include successes, partial successes, and failures.

None of the patients classified as the successful group had to be catheterized. Forty-six patients voided spontaneously after subcutaneous administration of 5 milligrams of beta methylcholine urethane repeated at 30 minute intervals for three times when necessary. Seventeen of the 46 patients voided after being given 5 milligrams of the drug and in the remaining 29 it had to be repeated once or twice. The drug was routinely repeated if the bladder could be percussed or if the patient remained uncomfortable because of bladder distention following the first or second dose. The number of successes was higher in the male group.

In the patients classified as partially successful one series of beta methylcholine urethane was given as outlined previously and the individual did not void. The patient was then catheterized. Eight to 10 hours later the pro-



TABLE II.—PROCEDURES RESULTING IN VOIDING FOLLOWING THE SUBCUTANEOUS ADMINISTRATION OF BETA METHYLCHOLINE URETHANE IN 76 CASES OF POSTOPERATIVE URINARY RETENTION

Procedure	No. of cases voiding	No. of cases not voiding	Per cent	Classification
A. Single 5 mgm. dose	17		22%	
B. Two or three 5 mgm. doses at 30 minute intervals	20		26%	
Total	37		68%	Successes
C. Three 5 mgm. doses at 30 minute intervals, followed by catheterization; drug repeated if necessary			14%	
D. Procedure C repeated once	7		9%	
Total			23%	Partial successes
E. Failure of the above procedures and some supplementary method used			1%	Failures

cedure was repeated if the patient was uncomfortable or if he desired to void and could not. The partial success cases are classified arbitrarily as those in which the drug-catheterization therapy was instituted one and two times. A total of 19 cases make up this group. Twelve of the 19 patients were catheterized once and 7 were catheterized twice and the drug was given as indicated.

Eleven patients in which the beta methyl choline urethane-catheterization procedure was repeated more than twice and in which some other method of treatment was started are classified as failures. We have also included in this group of 21 cases 4 patients who because of uncomfortable side actions of the drug preferred catheterization or some other mode of treatment to further administration of the drug.

The actions and side actions of beta methyl choline urethane as we observed them are summarized in Table III. These are listed under six general headings—circulatory urinary gastrointestinal glandular (secretory) respiratory and visual. Doses of 5 milligrams each repeated at 30 minute intervals as outlined previously did not cause any of the patients to have any alarming side effects although a few did become rather uncomfort-

TABLE III.—ACTIONS AND SIDE ACTIONS OF BETA METHYLCHOLINE URETHANE

	No.	Per cent
A. Circulatory		
Flushing	62	80
Sweating	62	80
Fall in blood pressure	24	30
Weakness	18	25
Pulse change	None had any significant change	
B. Urinary		
Bladder and/or urethral pain.	70	92
C. Gastrointestinal		
Increased peristalsis.	38	50
Flatus	26	35
Nausea	4	5
Nausea and vomiting	8	11
Defecation	4	5
Epigastric discomfort	4	5
D. Secretory		
Salivation	22	30
Lacrimations	8	10
E. Respiratory		
Bronchospasm	8	
F. Visual		
Miosis	4	5
No action.		

able after the second or third dose. It was not necessary to give atropine to any of this group of patients to relieve the side actions but we did give 0.9 milligram (1/75 gr.) subcutaneously to each of 10 patients to observe its effect and found that the parasympathetic actions of beta methylcholine urethane were relieved completely in 10 to 15 minutes by the atropine. Atropine was occasionally given to apprehensive patients when larger doses than 5 milligrams of urethane were administered and in no case did atropine fail to counteract the side actions completely. Flushing (80%) sweating (80%) and bladder pain urethral pain or both (92%) were the effects most frequently encountered and they usually occurred in this sequence. All patients who voided successfully following administration of the drug had bladder pain urethral pain or both. The symptoms of respiratory and visual side effects were usually elicited only on direct questioning of the patient. There was no significant change in the pulse rate and the systolic blood pressure did not fall more than 8 points in any patient. The drug proved to be a useful adjunct to the treatment of postoperative intestinal distention in 26 (35%) patients who passed flatus following the administration of the drug.

## DISCUSSION

It is, of course, difficult to evaluate accurately the effectiveness of any drug or procedure in the treatment of postoperative urinary retention for psychogenic factors play a large role in the problem. It has been repeatedly observed that functional retention is seldom seen in the postoperative mentally deficient patient. The value of beta methylcholine urethane is exhibited in its minimal toxic side reactions and in the fact that atropine will completely neutralize these side actions should they become excessive.

We have previously outlined what we consider the most effective method and drug dosages. The patient, if female, should be placed on a bedpan at the time of each administration or very shortly afterward. With male patients a urinal should be immediately available at the time of drug administration. The drug is usually effective in 5 to 15 minutes. It is probably more effective in male patients because of the greater simplicity of the urinal over the bedpan in voiding. The drug is given preferably on an empty stomach, before meals and more than 2 hours after eating or taking fluids orally. If the drug is given immediately after eating about one-third of the patients will develop nausea and vomiting. Beta methylcholine urethane seldom has to be repeated more than two or three times after the patient has voided one time and once it has been successful in emptying the bladder it is practically always successful on subsequent administration. We have observed no local reactions when the drug is given subcutaneously. One 5 milligram dose was inadvertently given intramuscularly. The patient urinated 700 cubic centimeters within less than 4 minutes and had rather accentuated and distressing side actions but these were relieved within 10 minutes by the prompt administration of 1/75 grain (0.9 mgm) of atropine subcutaneously. Better results are obtained if the drug is not given to apprehensive patients. We personally administered the drug and observed all the patients in the present group but in later cases left the administration to the supervising nurse, each dose being ordered separately and the procedure varied according to the effect of the preceding dose. The side actions, if pre-

sent, are usually more pronounced with the first series and decrease with each succeeding series. Adequate fluid intake is of great importance especially after the drug has been effective one time. The drug was found to be very effective in cases in which the patient was having urinary overflow or voiding small amounts spontaneously. The type of anesthetic agent used for the operative procedure apparently had little effect on the results obtained.

The mechanical effects of the operative procedure doubtless affect the results to be expected from any parasympathomimetic drug used in the treatment of functional postoperative urinary retention. Abdominal operations affect the action of the abdominal musculature used in aiding the voiding act. Our highest incidence of partial successes was in the group of patients who had anterior colporrhaphy, in which there was trauma and probably actual constriction of the tissues surrounding the urethra. The drug cannot be expected to act as successfully in the case of patients in whom part of the nerve supply to the urinary bladder is destroyed.

Beta methylcholine urethane is contraindicated in the presence of vesical neck obstruction, asthma, and hyperthyroid conditions. It would not seem wise to use it in patients after recent intestinal anastomoses, obstructive resections or other intestinal procedures where increased peristalsis might prove harmful. It should not be used in patients with coronary sclerosis, known heart disease, or in elderly individuals in whom tachycardia and a drop in blood pressure might lead to myocardial damage or infarction.

## SUMMARY AND CONCLUSIONS

1. Beta methylcholine urethane, a choline derivative, has been used in the treatment of 76 consecutive unselected cases of postoperative functional urinary retention.

2. The drug is stable, shows minimal side actions, and these can be completely counteracted by the use of atropine.

3. The drug was successful in relieving the urinary retention in 46 (60%) of the cases and partially successful in 19 (25%). Eleven (15%) cases were classified as failures.

4 The contraindications to the use of the drug for postoperative retention are vesical neck obstructions, asthma, hyperthyroidism recent intestinal anastomoses elderly individuals except cautiously in small doses and in individuals with coronary sclerosis or known heart disease.

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# THE EFFECT OF SULFATHALIDINE ON THE BLEEDING AND CLOTTING TIME OF THE BLOOD AND PROLONGATION REDUCTION BY THE ADMINISTRATION OF VITAMIN K

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**S**ULFATHALIDINE or pbthylsulfa-thiazole was introduced in 1943 by Poth and Ross (11). The antibacterial action of this compound effects a considerable reduction of the gram negative bacteria of the bowel, both anaerobic and aerobic organisms being susceptible. Sulfathalidine has from two to four times greater bacteriostatic activity than succinylsulfathiazole as indicated by the effect on coliform organisms.

Allen found that increased bleeding had occurred after 4 or 5 days of sulfasuxidine administration in one fifth of the patients with a carcinoma of the colon. Poth (8,9,10) observed an increase of bleeding in an occasional patient but stated that when sulfasuxidine was used the incidence of bleeding was not high.

Firor reported that in 2 patients with large ulcerating carcinomas of the colon the administration of succinylsulfathiazole had to be discontinued because of alarming hemorrhage. Sanders and Halperin reported postoperative hemorrhages accompanied by a low prothrombin level in 2 patients following the use of sulfasuxidine, and in both cases vitamin K intravenously administered stopped the hemorrhage. In both of these cases, the prothrombin level had been normal prior to the administration of sulfasuxidine. They believed that the marked reduction of vitamin K synthesizing colonic bacteria brought about by sulfasuxidine was partly responsible for the hemorrhagic phenomenon. They stated that since then they have routinely given synthetic vitamin K by mouth to all patients receiving sulfasuxidine.

Kornberg and Seberell studied the production of vitamin K deficiency in rats with sulfa-

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pyrazine sulfadiazine sulfathiazole, sulfaguanidine and succinylsulfathiazole and they found all of these drugs effective in varying degrees in producing rapidly and consistently a severe vitamin K deficiency with a significant prolongation of the clotting time of whole blood and with massive hemorrhages. They found that the order of effectiveness of the sulfonamide compounds used in the production of vitamin K deficiency was in direct proportion to their effectiveness in regard to bacteriostasis of coliform organisms in the intestines of the animals.

In man bacteria, one natural source of vitamin K, are of great practical importance. Almquist has reported that cultures of numerous organisms such as *Staphylococcus aureus*, *Escherichia coli*, *Bacillus subtilis* are all rich in vitamin K. The large amount of vitamin K formed and constantly absorbed by coliform organisms in the human bowel probably explained the difficulty with which hemorrhagic disease is produced in mammals by feeding a vitamin K deficient diet and the rarity with which simple nutritional deficiency of vitamin K is observed in man, as shown by Kark and Lozner. Kolmer states that hypoprothrombinemia may be caused by actual lack of vitamin K due to temporary sterility of the intestinal tract.

With these facts in mind and because clinically we have observed increased bleeding with the use of sulfathalidine, although Poth (8,9,10) and Allen have reported no increase we decided to observe the bleeding and clotting times of all patients receiving sulfathalidine. Poth has reported bleeding and clotting times to be normal when sulfathalidine was used. We determined the bleeding and clotting time of patients before sulfathalidine therapy

TABLE I.—BLEEDING AND CLOTTING TIME AFTER 5 DAYS' ADMINISTRATION OF SULFATHALIDINE

Case No	Diagnosis	Red blood count	White blood count	Bleeding time		Clotting time	
				Mm	Sec.	Mm.	Sec.
	Intestinal obstruction	3,730,000	800			3	30
		4,000,000	10,000			3	
	Rectal stricture, lymphogranuloma venereum	3,300,000	9,800			5	
		3,000,000	8,400		30		
1	Rectal stricture, lymphogranuloma venereum	3,600,000	7,000		5		45
		3,800,000	3,000			3	
4	Fistula in ano	4,000,000	8,400			5	
		4,000,000	10,000		30	3	45
2	Pelvic inflammatory disease	3,800,000	6,000		15		30
		3,800,000	7,300				
6	Carcinoma of colon	4,000,000	10,300		30	3	
		3,900,000	7,600		30	7	
7	Stab wound of splenic flexure of colon	—	—		30	3	
					30	4	
8	Fistula in ano	4,000,000	1,700		30	3	30
		4,600,000	7,800	3		7	
9	Carcinoma of splenic flexure	3,000,000	300				
		3,500,000	6,000	3			
10	Gastroenteritis	4,600,000	8,300		30	4	30
		3,000,000	9,800	3		3	
	Carcinoma of rectum	3,700,000	6,400		30		
		3,700,000	6,400	4		7	
	Osteomyelitis small intestine	3,000,000	14,000		30	3	
		4,000,000	8,500	3	30	5	15
13	Stab wound of splenic flexure	3,400,000	10,500		30		
		3,800,000	7,800		30	5	6
14	Appendicitis	4,800,000	3,500			3	
						7	
5	Pilonidal cyst	—	—		30		30
					15	3	
16	Hemorrhoidectomy	4,000,000	8,400		45		30
		4,000,000	7,800		30	3	
7	Pelvic inflammatory disease	4,800,000	7,100				30
		3,800,000	6,400		15	6	15
6	Carcinoma of rectum	3,400,000	8,300		45		
		3,000,000	6,000		27	6	

TABLE I—BLEEDING AND CLOTTING TIME AFTER 5 DAYS ADMINISTRATION OF SULFATHALIDINE—Continued

Case No.	Diagnosis	Red blood count	Wt./Hb blood count	Bleeding time		Coagulation time	
				Min.	Sec.	Min.	Sec.
19	Carcinoma of stomach	850,000	8,400	1	0	3	
		750,000	5,200	2		1	
20	Carcinoma of rectum	700,000	9,200		45	1	30
		3,400,000	6 00	1		8	
	Intestinal obstruction	4, 00,000	6,400		30		6
		4,300,000	5,200	3	0	7	
	Peptic ulcer	3,200,000	6,100		0	2	
		4,400,000	7,800	1	30	4	30
21	Peptic ulcer	3,700,000	700	1	6		30
		3,850,000	5,200			5	0
22	Intestinal obstruction	4, 00,000	00		6	3	
		3,200,000	5,400			4	
23	Intestinal obstruction	4, 100,000	,500		30	4	5
					45	6	30
24	Acute appendicitis	4,500,000	5,000		5	5	36
				4	20	6	40
27	Acute appendicitis	4, 100,000	4,900		45	4	30
					55	6	30
28	Acute gastroenteritis	4, 000,000	7,000		55	4	5
					50	4	20
29	Rectal stricture lymphogranuloma venereum	3,800,000	6,500		55	4	7
				4	45	7	5
30	Penetrating stab wound of ileum	3,000,000	8,500		47	3	55
					40	3	55
31	Rectal stricture lymphogranuloma venereum	3,750,000	7,200			4	5
					5	4	40
32	Intestinal obstruction	4, 130,000	,500		45	5	30
					40	4	
33	Acute appendicitis	4,250,000	5,500		30	3	10
				4	3	6	5
34	Rectal stricture lymphogranuloma venereum	3,650,000	500	3		4	4
				4	5	6	45
35	Carcinoma of rectum	3,400,000	9,200		40	4	30
				4	5	7	5
36	Intestinal obstruction	3,900,000	13,300		55	3	40
					50	4	
37	Carcinoma of splenic flexure	3,300,000	8,200	1	30	5	20
				4	50	7	30
38	Stab wound of transverse colon	4,200,000	7,200		25	3	20
				3	4	6	40
39	Intestinal obstruction	4,200,000	,200		55	3	45
				3		6	55

TABLE I.—BLEEDING AND CLOTTING TIME AFTER 5 DAYS' ADMINISTRATION OF SULFATHALIDINE—Continued

Case No.	Diagnosis	Red blood count	White blood count	Bleeding time		Clotting time	
				Min.	Sec.	Min.	Sec.
40	Intestinal obstruction	4,600,000	11,500		20	4	1
41	Intestinal obstruction	2,000,000	14,300	3	40	3	15
42	Omnish wound of ileum and large bowel perforation	4,100,000	9,300		35		20
43	Stab wound of transverse colon	3,730,000	8,300	3	20	5	20
44	Gangrenous appendicitis	5,050,000	5,300		30	3	20
45	Gangrenous appendicitis	4,600,000	14,300	3	5	3	15
46	Omnish wound of transverse colon	4,250,000	9,300	5	20	5	20
47	Rectal stricture, lymphogranuloma venereum	2,650,000	1,300	3	45	7	20
48	Ischioanal abscess	3,450,000	5,300		20	3	15
49	Multiple fistula in ano	3,750,000	14,500		45		20
50	Perirectal abscess	3,800,000	1,300		5		20
51	Intestinal obstruction	2,700,000	9,300	3	45	6	20
52	Gastroenteritis with severe diarrhea	4,600,000	14,300	4	5	7	20
53	Rectal stricture, lymphogranuloma venereum	3,650,000	800		20		15
54	Gangrenous appendicitis	4,150,000	16,300		5		45
55	Gastroenteritis with diarrhea	4,600,000	1,700		45		20
56	Ischioanal abscess	3,450,000	5,300	3	45	6	20
57	Acute appendicitis	4,150,000	14,500		20	3	1
58	Rectal stricture, lymphogranuloma venereum	3,300,000	7,500	3	5	6	20
59	Fistula in ano	4,100,000	8,300		15	3	20
60	Hidradenoma of the rectum	3,600,000	9,300	3	20	6	20

TABLE I.—BLEEDING AND CLOTTING TIME AFTER 5 DAYS ADMINISTRATION OF SULFATHALIDINE—Continued

Case No.	Diagnosis	Red blood count	White blood count	Bleeding time		Coagulation time	
				Min.	Sec.	Min.	Sec.
6	Intestinal obstruction	4,000,000	10,300	1	20	3	
				3	30	7	15
6	Stab wound of hepatic flexure	3,750,000	8,600	1	45	3	40
				3	30	7	5
63	Acute appendicitis	4,300,000	1,30		15	3	
					1	3	45
64	Rectal abscess	3,500,000	14,500	1	5	3	10
				3	50	6	15
65	Carcinoma of rectum	3,300,000	1,600		1	4	
				3	30	6	25
66	Fistula in ano	4,000,000	8,450	1	50	3	5
				3	10	6	5
67	Stab wound in transverse colon and stomach	3,550,000	9,700		45	3	5
				1	50	3	30
68	Acute gastroenteritis	4,300,000	10,300		50	3	40
				2	2	4	
69	Acute appendicitis	4,400,000	13,300		55	3	45
				3	5	7	5
70	Rectal stricture, lymphogranuloma venereum	3,800,000	9,300		0	3	30
				3	55	6	40
7	Intestinal obstruction	4,150,000	1,500		40	3	35
				3	3	7	10

was started and after the patient had been given sulfathalidine for 5 days. The bleeding time (13) was determined by a puncture wound of the finger. The time of the appearance of the first drop of blood was noted. Each drop as it formed was removed with filter paper. The time that the bleeding stopped was noted. The time interval between the appearance of the first drop and the removal of the last represented the bleeding time.

Coagulation time (3) was determined in the following manner. Several drops of blood from a puncture wound of the finger were placed on 3 glass slides. At intervals of 15 seconds a needle was drawn through one of the drops, when shreds of fibrin clung to the needle and were dragged along by it, coagulation had taken place and this time was then noted as coagulation time.

In 71 patients in the series bleeding and clotting time was observed before and after

the administration of sulfathalidine therapy and the results are given in Table I. The first 5 patients received a dosage of 5 grams of sulfathalidine per day and the rest of the patients a dosage of  $\frac{1}{4}$  gram of sulfathalidine per kilo in 6 divided doses.

In 29.5 per cent of the patients given sulfathalidine therapy there was an increase in the bleeding time of more than 2 minutes over the level before the drug was started and in 53.5 per cent of the patients there was an increase of over 2 minutes in the clotting time. In 70.5

TABLE II.—INCREASE IN BLEEDING AND CLOTTING TIME IN 9 CASES

	Increase in bleeding time	Increase in clotting time
Over 1 minute	5	—
Over 2 minutes	3	4
Over 3 minutes	1	1
Over 4 minutes	—	2
Over 6 minutes	—	1
Over 8 minutes	—	1



TABLE III—PATIENTS RECEIVING SULFATHALIDINE PLUS AN AMPULE OF VITAMIN K TWICE DAILY

Case No.	Diagnosis	Red blood count	White blood count	Clotting time		Coagulation time	
				Mins.	Sec.	Mins.	Sec.
	Inguinal hernia	4,800,000	7,500		5	4	5
						5	30
	Rectal stricture lymphogranulosa venerea	2,530,000	8,800		30	5	30
					5	4	30
1	Acute gangrenous appendicitis	4,300,000	5,300		5		
					30	5	
	Rectal stricture lymphogranulosa venerea	3,650,000	8,800			5	
					5	5	5
5	Acute gangrenous appendicitis	4,500,000	6,500				5
							45
6	Rectal stricture lymphogranulosa venerea	5,750,000	8,400	5			30
					5		30
7	Acute gangrenous appendicitis	3,050,000	7,300		30	5	5
					45	5	
8	Carcinoma of stomach	4,050,000	7,400		30		45
					5		30
9	Rectal stricture lymphogranulosa venerea	3,850,000	9,800		30	4	30
				5	30	5	
10	Rectal stricture lymphogranulosa venerea	3,450,000	7,300	5	55	5	
					30	5	
	Carcinoma of sigmoid	3,750,000	6,400		40	5	30
				5		6	25
	Carcinoma of rectum	3,550,000	8,700	5	5	7	30
					50	5	
	Carcinoma of rectum	3,300,000	7,300		5	6	25
					30	5	15
	Acute gangrenous appendicitis	4,500,000	6,500		30	5	30
					45		45
11	Rectal stricture lymphogranulosa venerea	3,600,000	7,900	5	30	5	5
					30		30
12	Stab wound of descending colon	4,500,000	8,500		45		45
				5	30	5	30
17	Stab wound of ascending colon	4,500,000	7,500	5	30	6	
					30		15
18	Intestinal obstruction	3,500,000	7,000	5	30	7	
							45
	Necrosis of sigmoid	3,800,000	8,500		5	7	25
					5	5	40
19	Intestinal obstruction	4,800,000	13,500		30	4	5
					45	4	15
	Acute appendicitis	4,500,000	14,800	5		4	55

TABLE III—PATIENTS RECEIVING SULFATHALIDINE PLUS AN AMPULE OF VITAMIN K TWICE DAILY—Continued

Case No.	Diagnosis	Red blood count	White blood count	Bleeding time		Clotting time	
				Min.	Sec.	Min.	Sec.
12	Multiple fistulae in ano	2,650,000	5,500		30	3	30
					45	3	30
13	Gonshot wound of abdomen and transverse colon	2,030,000	8,200		45	3	30
				3	45	6	0
14	Acute appendicitis	2,250,000	7,300		1	3	15
					45	3	30
15	Intestinal obstruction	2,750,000	4,000		45	3	30
						3	30
16	Fistula in ano	2,850,000	9,500		5	4	
				4	5	7	0
17	Carcinoma of hepatic flexure	2,430,000	8,000		30	3	45
					5	3	45
18	Carcinoma of rectum	2,650,000	8,700		45	3	5
				3		6	5
19	Carcinoma of sigmoid	2,850,000	9,200	8		4	5
					0	4	
20	Intestinal obstruction	4,200,000	9,500		45	4	15
				3	0	4	45

per cent of the patients there was an increase in the bleeding time of at least 1 minute over the time before sulfathalidine administration was started, and in 78.8 per cent of the patients receiving sulfathalidine ingestion there was an increase in the clotting time of over 1 minute.

Allen as previously quoted stated that in one fifth of the patients with carcinoma of the colon he found that increased bleeding occurred after 4 to 5 days of sulfasuxidine administration. With sulfathalidine therapy we found an increase in the bleeding and clotting time in all 9 patients with carcinoma of the large bowel as shown in Table II.

After we started to administer vitamin K to all patients receiving sulfathalidine therapy we obtained the following results. In 7 patients with carcinoma there was no change in the bleeding and clotting time of 6. In 1 patient there was observed the following change: the bleeding time increased from 1 minute 45 seconds to 3 minutes, and the clotting time from 3 minutes 15 seconds to 6 minutes, 15 seconds.

We then started to give vitamin K, 5 milligrams twice per day to the patients receiving sulfathalidine therapy, and in this group of 30 patients there was no change in the bleeding or clotting time of 22 patients or in only 8 cases was the bleeding and clotting time elevated and then by only 1 minute. Thus there was an increase in the bleeding time in 26.6 per cent of the patients who received vitamin K and sulfathalidine as compared to 70.5 per cent of the patients who did not receive vitamin K, and the clotting time was elevated in 26.6 per cent of the cases as compared to 78.8 per cent.

A detailed analysis of the results which were obtained in these cases is to be found in Table III.

#### CONCLUSIONS

From our observations of the bleeding and clotting time of 71 patients the following conclusions were reached:

1. When administered in therapeutic doses sulfathalidine increased the bleeding and clotting time in these cases.



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that of Antoine Lembert. M Lembert reported to the surgical section of the Royal Academy of Medicine in Paris his experimental work on dogs in which he had devised a method of suture which allowed the intestinal wound edges to heal rapidly and with excellent approximation. Altogether he had operated upon 5 dogs. All 5 dogs lived. He further observed that the operative procedure in most of the dogs scarcely interrupted their normal habits of eating and elimination. This report was made January 26, 1826. This method of suture is the basis of our modern technique in intestinal surgery. We speak of it as the Lembert suture.

Since this early report on the works of M Reybard to the French Royal Academy of Medicine surgery of the colon has passed through many painful phases. Although colostomy was known and had been performed by Pillare (10) in 1776 and successfully by Duret (10) in 1793 surgical resection of the diseased colon had not been reported. In fact during this period, the only relief offered patients suffering from cancer of the distal colon according to Thomas Copeland was the cauterization of the very painful hemorrhoids which developed as a consequence of the obstructed circulation in the parts. Copeland described the late stage of the disease very accurately. He states "introduction of the finger into the rectum will be opposed by a hard ring of cartilagenous feel composed of the diseased inner ring of the intestine." He also observed that despite vigorous treatment of the piles the true nature of the disease went unrecognized. According to Dinnick whose excellent and very thorough work, *The Origin and Evolution of Colostomy* was published in 1934 it was not until the middle of the 19th century that colostomy became widely used.

From the general surgery service Temple University Hospital, and from the surgical service of Dr. W. W. Babcock, Temple University Hospital.

Abdication of thesis submitted in March, 1943, by Dr. Cooke as required for the degree of M.S. in Surgery.

2 The administration of vitamin K reduced this prolongation of the bleeding and clotting time in most instances.

3 All patients who receive sulfathalidine preoperatively and postoperatively should at the same time, receive vitamin K in order to prevent a vitamin K deficiency and an increase in the bleeding and clotting time.

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Dunnick states that Amussat (10) one of the foremost French surgeons of that time rescued (colostomy) from the realm of the occasional and heroic and advanced it to its proper place in surgery. In 1839 Amussat analyzed all the reported colostomies, of which there had been a total of 29 cases. From this critical survey and his own research into the anatomy of the colon he published his concept of when and how colostomy should be performed. This teaching fell on fallow ground, and the palliative colostomy became the accepted method of treatment of carcinoma of the colon.

In the year 1882 Bryant described a procedure in which resection was done after exteriorization of a portion of the colon and 10 years later Bloch of Copenhagen utilized the same principle. In 1895 Paul of Liverpool reported to the British medical profession his historic series of 7 cases of exteriorization and resection of the colon. In the author's own words this series represents the education of a surgeon. Although the end results in these cases were not good the careful analysis given each case and the application to the next operation of that which had been learned from the preceding one led Paul to the development of the operative procedure which today bears his name. This procedure received even more widespread acclaim after the publication of the excellent work of Mikulicz in 1903. Because of this work and the way it was presented to the medical profession this form of surgical treatment became known as the Mikulicz or the Mikulicz-Paul operation. The reason for this acclaim and almost universal acceptance of this procedure is obvious. At last some method of treating carcinoma of the colon had been devised which gave reasonable promise of curing the cancer without killing the patient. That dread scourge peritonitis, which attended all open intra-abdominal surgery had been relegated to a minor role. Mortality had been reduced from an almost prohibitive level to a relatively benign 15 to 20 per cent by this method.

Surgery of the rectum and rectosigmoid had also made important strides. In the year 1885 just a few years after the first published papers on exteriorization and resection of the colon Kraske (23) presented to the Fourteenth Con-

gress of German Surgeons an operative procedure which bears his name the Kraske perineal resection of carcinoma of the rectum. This method had many disadvantages, the most disturbing of which was the high percentage of recurrence of the tumor. Kraske himself realized this and in 1906 he reported a series of 10 cases in which the original technique had been modified to include an abdominal procedure which mobilized the rectosigmoid and rectum prior to removal through the perineum. Miles went a step further and brought the colostomy out on the abdominal wall. There it was to remain until Babcock (2) in 1932 proposed that the colostomy be returned to the perineum whence it came. In addition to perineal colostomy Babcock has long been a proponent of radical extirpation of carcinoma of the colon with preservation of functioning anal sphincters. Recent publications (3-4) on this subject outline his technique in detail. A type of sphincter saving operation had been reported as early as 1923 by Lockhart Mummery (16) who also called attention to the unnecessary sacrifice of the anal sphincters in many cases of carcinoma of the rectum and rectosigmoid.

At the turn of the century we see that medicine had advanced to the stage in which the objective was an attempt by radical excision of the tumor and the adjacent tissues to rid the patient of his cancer. Great strides had been made in surgery. This was a far cry from the hemorrhoidectomies of Copeland a time or the palliative colostomies of the 19th century. In spite of the excellent results reported by the advocates of these procedures, many surgeons still maintained an interest in an operation which would immediately re-establish continuity of the bowel following resection and thus eliminate the prolonged hospitalization and numerous surgical procedures necessitated by exteriorization of the bowel. As the anatomy and physiology of the intestinal tract became better understood, pioneering surgeons sought some method of colon anastomosis which would eliminate the troublesome Mikulicz and yet would not compromise the safety obtained by that procedure. Notable among these was the Johns Hopkins group the members of which, led by Halsted, became very active in experi-

mental work on intestinal anastomosis. In 1910, Halsted published his paper on the bulk head method of aseptic intestinal anastomosis. This was a very earnest effort to eliminate contamination at operation. In Halsted's own words, 'for the large intestine the circular suture or end-to-end anastomosis would if equally safe, be conceded to be the ideal method. Another method proposed by this group utilizing the basting stitch principle was published in the Johns Hopkins Hospital bulletin of 1908 by Parker and Kerr. The major obstacle to overcome in this suture and one which frequently occurred in experimental animals was the tendency for the formation of a diaphragm at the site of resection. All in all, these were important contributions and despite the disadvantages of each method something was learned with each painstaking step.

In 1917, in a very excellent work, Lockhart Mummery (17) described the technique which he utilized in open end-to-end anastomoses of the colon. By carefully packing off the peritoneal cavity at the time of operation and by careful attention to preoperative and post-operative care be believed that this procedure could be accomplished with reasonable success. The technique described in that treatise has scarcely been improved upon today.

In the years to follow end-to-end anastomosis of the colon was not widely used. Instead the Mikulicz extensorization principle for carcinoma of the colon was utilized by most clinics. For cancer of the rectosigmoid and rectum, in which extensorization was impossible, the abdominoperineal resection of Miles became the accepted treatment.

In 1939 a very important contribution to colon surgery was made. Garlock and Seeley published their report on the effect of oral sulfanilamide on intestinal bacteria. Since that report new and less toxic sulfanilamide products have been developed, and bacterial flora in the colon can be reduced to a minimum (26). At long last the proponents of one stage end-to-end anastomosis had added to their armamentarium the last necessary link. Peritonitis from contamination at operation had finally been successfully controlled.

Progress in colon surgery had been slow but steady. First began the development of the

technique of intestinal surgery the corner stone of which was the development of the Lambert suture. Next, perhaps was the gradual understanding by the medical profession of the anatomy and physiology of the gastrointestinal tract and particularly the absolute necessity for decompressive measures in cases of obstruction. This knowledge coupled with the evolution of the blood bank and the development of modern anesthetic methods and finally the elimination of gross contamination at operation as a major factor has brought us to the excellent method of treating carcinoma of the colon, first described by Reybard of Lyons 115 years ago.

#### TREATMENT IN 79 CASES

This paper is a survey of all end-to-end one stage anastomoses of the colon performed in the Temple University Hospital during the years 1945, 1946 and 1947. No ileocelectomies or perineal resections are included in this series.

There is no attempt in this paper to deal with the rate of cure in patients afflicted with carcinoma of the colon but rather to ~~compare~~ these cases from the standpoint of operative mortality morbidity directly or indirectly contributed to by the operation and finally the end results of the operative procedures. Altogether there have been 79 cases in which resection of the colon with one stage end-to-end anastomosis was done. The majority of the lesions for which resection was done were malignant. A few, 14 in number, were benign. Four of the patients, for reasons to be explained later, were reoperated upon and resection again carried out at the same site.

There were 6 deaths from all causes which is a mortality rate of 7.5 per cent (Table I).

TABLE I.—DEATH IN 6 CASES

Cause of death	Case No.	Anteop.	Post-operative
Coronary occlusion	8 64	7%	15 hours
Coronary occlusion and cerebral embolus from mural thrombus	4	7%	15 days
Peritonitis	23	0	9 days
Small bowel obstruction	50	7%	15 days
Sepsis (wound infection pyelonephritis-B. proteus, septicemia-B. proteus)	27	0	4 days
			21 days

If the 2 cases of coronary occlusion and the 1 of cerebral embolus are excluded the corrected mortality for 83 resections in 79 patients is 3.7 per cent.

Morbidity includes all complications directly or indirectly resulting from the operative procedure in the entire postoperative period. These cases will be discussed in more detail later.

**Preoperative preparation.** The preparation of these patients for surgery followed the same general pattern: complete mechanical cleansing of the bowel by purgatives and enemas followed by oral sulfasuxidine or sulfathiazidine, occasionally oral streptomycin and a low residue diet. Blood chemistry and hemoglobin levels were corrected in this preoperative period when necessary. In a few of these patients obstruction was present when they were admitted to the hospital and decompression was accomplished by either the Miller Abbott tube and 100 per cent oxygen inhalations or some form of colostomy. The method of decompression utilized depended largely upon the degree of obstruction and its duration.

**Technique.** The surgical technique falls into two general classifications: the open method of anastomosis and the closed or aseptic method in which a Furness clamp or a modification of it was used.

In the open technique the operative field was protected from gross contamination by rubber-shod Scudder clamps placed a comfortable distance from the severed ends of the bowel and complete isolation of the area with abdominal packs. In the majority of cases two rows of inverting sutures were used although in a few cases, only one row of interrupted silk completed the anastomosis. Gloves were changed and clean instruments used after completion of this stage of the procedure. Twenty-eight anastomoses were performed in this manner. One of the patients had a proximal vent in the form of a cecostomy established at the time of operation. Four patients had a functioning colostomy previously established because of obstruction when they came to the operating room.

The closed or aseptic technique made use of the Furness clamp and pin or a modification

of it. One method (3-14) of applying this clamp is to bring both segments of the bowel together at the site of proposed resection. The clamp is applied so that it includes both proximal and distal bowel with a loop above. The loop of bowel above the Furness clamp which includes the diseased portion is cut away below a Payr or another type of crushing clamp. When the Furness clamp is removed the pin holds both proximal and distal segments of bowel. After the anastomosis the pin is removed and the lumen of the bowel re-established by the operator's fingers. The other method of aseptic anastomosis utilizes two Furness clamps and two pins. The bowel is resected between the two clamps. When the suturing is to begin the two pins are approximated and the sutures placed. In general two rows of sutures were used. Fifty-five closed anastomoses were performed in this series. In these 55 procedures there were 33 with proximal vents, either appendicostomy, cecostomy or colostomy established at the time of operation. Four patients came to operation with some form of functioning colostomy which had been established previously because of obstruction.

**Complications.** Postoperative complications were many and varied. Those resulting in death have been listed. The case reports of the patients who died and of those contributing to the morbidity rate will be discussed in the following paragraphs.

#### CASE REPORTS

There were 3 cases of peritonitis. In 1 of these localization occurred and drainage was successful.

**CASE 83.** S. R., aged 53 years, male. The diagnosis was carcinoma of the descending colon, with no metastases. Aseptic anastomosis without proximal vent was done. His progress was good, bowels began to move on the 3rd day after operation. On the 10th day a localized intra-abdominal abscess was drained through the outer edge of the wound. The patient was never very ill, but because of the localized peritonitis, was not discharged until the 24th postoperative day. The operative result was good.

The other 2 cases of peritonitis detailed in the following paragraphs are also listed in our mortality column.

**CASE 73.** D. R., aged 63 years, female. This patient had carcinoma of the descending colon. The

operation was resection and aseptic anastomosis with complementary appendicostomy. She was reoperated upon on the 8th postoperative day because of mechanical ileus and at this time an ileostomy was done. Eleven days after the first operation the patient was operated upon again and drainage established for the peritonitis. She died of peritonitis on the 18th postoperative day. No autopsy was obtained. Although it was believed because of the findings at later operation that peritonitis was not a result of a leak at the colon anastomosis, this patient was signed out as death due to peritonitis following colon resection because of the lack of autopsy proof.

CASE 64. M. A. aged 67 years female. The diagnosis in this case was colloid carcinoma of the transverse colon. Operation was resection and closed end-to-end aseptic anastomosis without proximal vent. Progress was apparently satisfactory until the third postoperative day when the temperature began to spike to 102. On the 6th postoperative day by x-ray examination the distention was interpreted as obstruction at the hepatic flexure. The patient was operated upon and cecostomy done. At operation turbid intraperitoneal fluid was found, positive culture, nonhemolytic *Staphylococcus albus* also dilated small bowel. Cecum and terminal ileum were not distended. The patient responded slowly. Following cecostomy temperature continued to spike up to 102 daily. The patient was gotten out of bed and apparently was recovering with bowels moving well when she suddenly went into shock and died 6 days after cecostomy and 12 days following resection. Autopsy revealed coronary thrombosis as the immediate cause of death. She also had minimal peritonitis from a small leak at the anastomosis.

In 6 cases postoperative small bowel obstruction occurred.

In 2 of these cases there was evidence of obstruction in the immediate postoperative period which was successfully treated with the Miller Abbott tube.

CASE 79. A. S. aged 48 years female. Diagnosis was carcinoma of the rectosigmoid. Operation was resection and open end-to-end anastomosis without proximal vent. The patient responded well until the 4th postoperative day when distention became evident and the next day x-ray examination revealed small bowel obstruction. Miller Abbott tube was passed and obstruction was relieved. The patient was discharged on the 15th postoperative day.

CASE 67. D. S. aged 48 years male. This case will be discussed in more detail under late obstructions. It is included here because the Miller Abbott tube was used until the 22nd postoperative day. Following the removal of the tube the patient was discharged in apparently good condition.

In 1 case a cecostomy was done 3 days after operation.

CASE 1. M. S., aged 63 years, male. The diagnosis was carcinoma of the sigmoid. The lesion was resected and a closed type anastomosis without a proximal vent was performed. The patient showed evidence of distention early in the postoperative period. This was unrelieved by the Miller Abbott tube and on the 3rd day a cecostomy was done as a decompressive measure. Following this the patient's condition improved and except for a febrile response the postoperative course was smooth.

The following cases were readmissions of patients who had developed ileus a considerable time after resection. This type of complication can and does follow any type of abdominal surgery but for the sake of completeness they are included here.

CASE 8. C. H., aged 56 years female. Diverticulitis of the sigmoid was diagnosed. Resection and aseptic end-to-end anastomosis with complementary cecostomy were performed. The patient apparently had an uneventful postoperative course was on liquids on the second day and soft diet on the sixth day. She was discharged on the 28th postoperative day. No reason is given on the chart for this prolonged stay. Presumably the patient wished to remain until the cecostomy was completely healed. Nine months later she was readmitted with chronic obstruction. Operation revealed many dense adhesions about the old scars (hysterectomy and sigmoidectomy). Separation of these adhesions apparently relieved the patient's symptoms. She has been well for 18 months.

CASE 67. D. S. aged 48 years, male. Volvulus recurrent with stenosis at the base of the volvulus was the diagnosis in this case. After adequate preparation the redundant sigmoid was resected and an open end-to-end anastomosis done without proximal vent. A Miller Abbott tube had been passed preoperatively. The course in the hospital was not uneventful. Each attempt to close the Miller Abbott resulted in abdominal distention. Although the patient was taking food well the Miller Abbott tube was not removed until the 22nd day. The impression was that the small bowel had been obstructed by adhesions. After being free of symptoms this patient was readmitted 18 months later with obvious mechanical small bowel obstruction. Operation revealed a narrow adhesion obstructing the lower jejunum. Smooth postoperative course followed lysis of this adhesive band. There has been no recurrence of symptoms.

The other 2 cases of intestinal obstruction are listed in our mortality column.

CASE 50. J. H. aged 73 years male. This patient had carcinoma of the transverse colon. After suitable preparation resection of the tumor and an aseptic end-to-end anastomosis was done without a proximal vent. The patient responded well after operation and was making an apparently normal re-

covery until the 3rd postoperative night when he complained of abdominal pain and began to vomit. This condition went unrecognized until the following morning at which time the patient was quite ill and in a state of vascular collapse. Under local anesthesia the abdomen was explored and a high intestinal obstruction was found. The walls of the distended jejunum were dusky blue in color. The obstruction was relieved but the patient failed to respond and died a few hours later. Autopsy was obtained and corroborated the clinical findings.

CASE 73 D R., aged 63 years, female. This case has already been described under peritonitis which was the cause of death although a small bowel obstruction was found at second operation. Autopsy was not obtained and complete analysis is, therefore impossible.

Failure of the anastomosis to function occurred in 4 cases. These are described in detail below.

CASE 63 A. S., aged 43 years, male. Diagnosis was ulcerative colitis. The distal two-thirds of the transverse colon, descending colon and the proximal two-thirds of the sigmoid were resected. Anastomosis between proximal transverse colon and distal sigmoid was the open type. A functioning ileostomy had previously been established. The postoperative course was completely uneventful. Sixteen months later the patient was readmitted because of obstruction. Operation at this time revealed that extreme tension between the transverse colon and sigmoid had elongated and narrowed the lumen to such an extent that it was partially obstructed. A resection and closed end-to-end anastomosis was done with complementary appendicectomy. Postoperative course was uneventful and patient was discharged on the 30th day.

CASE 10 M. P., aged 38 years, female. Carcinoma of the sigmoid was the diagnosis. The sigmoid was resected and an aseptic end-to-end anastomosis performed with complementary cecostomy. The postoperative course was good for the first few days. The cecostomy was allowed to close. On the 17th day it was apparent that there was obstruction at the site of the anastomosis and a colostomy was done. Four weeks after the original operation another resection was carried out and an aseptic closure made. The excised specimen showed a complete diaphragm had formed at the site of the original anastomosis. The course following this procedure was uneventful and the patient was discharged on the 15th day.

CASE 29 M. P., aged 63 years, female. Diagnosis was redundant sigmoid—obstruction severe. After adequate preparation the sigmoid was resected and an aseptic end-to-end anastomosis performed with complementary cecostomy. The patient responded well for the first few days, but it soon became apparent that something was wrong at the site of anastomosis. Obstruction persisted despite efforts to stimulate late movement via the cecostomy. The tem-

perature and pulse were normal, however and the patient was not ill. On the seventh day she was re-operated upon. A small area of necrosis was found at the site of resection. A rectal tube was passed from below up through the anastomosis and a drain placed retroperitoneally down to the suture line. Following this maneuver the patient made a normal recovery.

CASE 56 H. K., aged 60 years, male. This patient had had several operations for peptic ulcer elsewhere. On admission there was evidence of gastrocolic fistula. At operation, an anterior and a posterior gastroenterostomy were found. The loop encircled and compressed the colon. A marginal ulcer with colonic fistula and a chronically perforating duodenal ulcer were present. A partial gastrectomy with resection of the involved jejunum was completed. The obstructed colon was then resected and an aseptic end-to-end anastomosis was performed without a proximal vent. The patient responded well but on the 7th day it was evident clinically and by x-ray examination that obstruction existed at the site of colon anastomosis. A cecostomy was done. On the 27th day a plastic procedure on the colon established an adequate lumen. The patient was discharged with a good operative result.

There were 3 cases of coronary occlusion. Two of these are of particular interest because they occurred just a few hours after completion of operation.

CASE 81 F. W., aged 70 years, male. Diagnosis was carcinoma of the sigmoid. In addition the patient had hypertension (diastolic blood pressure 166/95) and gave a history of having had a coronary occlusion 3 years before admission. After suitable preoperative preparation the patient was operated upon and an aseptic end-to-end anastomosis with a complementary cecostomy was performed. During the operation which was done under spinal anesthesia, the blood pressure dropped to 75/50 where it remained for 30 minutes. It gradually rose until at the end of an hour and 15 minutes it had risen to 115/70. The patient was returned to his room in apparently good condition. Two hours later he suffered a heart attack and died 3 hours after operation. Autopsy revealed the suspected coronary occlusion.

CASE 42 F. H., aged 57 years, male. Diagnosis was carcinoma of the sigmoid partially obstructing. The obstruction was relieved by the Miller Abbott tube enemas and oxygen inhalations. After suitable preparation the patient was operated upon and resection of the sigmoid in the open manner without a proximal vent was performed. During the operative procedure the blood pressure remained fairly constant. Before anesthesia, continuous spinal, the blood pressure was 90/70. Twenty minutes after the spinal was given, the pressure dropped to 70/50 where it remained for 30 minutes. Toward the end of the procedure it again dropped to 70/50 where it

remained for 15 minutes. With stimulants it rose to 100/70. One hour and 30 minutes after operation the patient experienced severe subabdominal pain. Electrocardiogram revealed a posterior infarction. The cardiac disease responded to therapy and the anastomosis was functioning well, soft diet, and bowels moving until the evening of the 8th day at which time the patient had a cerebral accident. Twenty-four hours later there was extension of this process and the patient died. Autopsy revealed a cerebral embolus originating probably from the mural thrombus, as the cause of death. The myocardial infarction was demonstrated.

These cases of coronary occlusion which occurred within a few hours after operation can not be dismissed with a wave of the hand and classified as unavoidable catastrophes. In both of these patients a cardiac history was obtained. In the first case a definite history of infarction was given and in the second a history of anginal pain of such magnitude that the patient had seen a cardiologist was discovered after operation. Both patients were cardiac problems before they developed cancer. The type of anesthesia to be used in such cases is always a problem. Spinal was used in both cases. The wisdom of this choice is open to question. The important point is to see that there is no drop in blood pressure for an appreciable period during the operative procedure. In any event in a certain percentage of these cases death will result from cardiac disease.

The third case of coronary occlusion has already been reported under peritonitis. That is Case 64. The occlusion was brought on in all probability by the patient's stormy postoperative course.

Several other cases presented complications which should be considered.

The following case is listed in our mortality column.

CASE 27. E. R. aged 68 years female. The diagnosis was carcinoma of the sigmoid with complete obstruction on admission. From the history the duration of the obstruction was 3 weeks. Cecostomy was performed as a decompressive measure. The patient was quite ill and 2 weeks were spent in preparation for definitive surgery. The sigmoid was resected and open anastomosis done. Preparation of the bowel was definitely not good. The cecostomy was inadequate. The immediate postoperative period was fairly good, despite the fact that there was a temperature elevation up to 104. On the 9th day a

urine culture was positive and the urine was loaded with pus cells. During this period the patient was having on the average of three stools per day. Careful examination of the operative site revealed no evidence of intra-abdominal infection. The wound was superficially infected. Temperature began to rise on the 10th day. The organisms (*Bacillus pyocyaneus*) in the urine and wound failed to respond to antibiotics. This situation continued and the patient died on the 24th day. Prior to death a positive blood culture of *Bacillus pyocyaneus* was obtained. This death was attributed to sepsis. No autopsy was obtained.

Urinary fistula occurred in 1 case.

CASE 37. F. M. aged 51 years female. Diagnosis was sigmoid carcinoma. The patient was adequately prepared and resection with an aseptic anastomosis with complementary cecostomy was performed. During the operative procedure the left ureter was divided and anastomosed. In the postoperative period the patient developed urinary fistula and later it became necessary to do a nephrectomy. She recovered and has remained well since.

In the next case the patient developed a fecal fistula.

CASE 12. J. R. aged 59 years female. This patient had diverticulitis of the sigmoid. She was admitted with two colostomies, one at the sigmoid and the other at the ascending colon. In addition this patient had fistulous tracts and abdominal wall abscesses. After incision and drainage of the abscesses and adequate preparation of the bowel a closed type of resection was done at which time the sigmoid colostomy was eliminated. The postoperative course was not eventful and after closure of the colostomy the patient was discharged. Two months later she was readmitted. A fecal fistula had developed at the site of the sigmoid anastomosis. After adequate drainage of this tract and preparation of the bowel the involved area was resected and an open anastomosis done with complementary appendicectomy. Recovery was uneventful.

The following case is presented because two resections were done at the same site.

CASE 70. J. S. aged 59 years male. Diagnosis was carcinoma of the sigmoid. After adequate preparation the sigmoid was resected and anastomosed openly without a proximal vent. Postoperative course was uneventful. Microscopic examination revealed that tumor existed in the cut edge of some of the tissue removed and so on the 12th day the patient was reoperated upon and resection again done at the same site. Open anastomosis without proximal vent was performed. Recovery was otherwise uneventful. A superficial abscess was drained on the 7th day. Patient was discharged on the 14th day.

There were no cases of pulmonary embolism in this group but 2 patients developed signs and symptoms of phlebothrombosis. Neither of these cases was serious and both responded well to anticoagulant therapy.

**CASE 5:** A. C., aged 71 years, female. Diagnosis was carcinoma of the transverse colon which, on admission, was causing obstruction. The obstruction was relieved by use of the Miller Abbott tube and enemas. The patient was operated upon and aseptic anastomosis accomplished without proximal vent. At the time of operation the Miller Abbott tube was at the site of the lesion. Postoperative course was uneventful except for signs and symptoms of phlebothrombosis which became apparent on the 7th day. This was successfully treated with anticoagulants and the patient was discharged on the 17th day.

**CASE 43:** B. W., aged 64 years, male. The diagnosis was carcinoma of the rectosigmoid. Resection and open end to-end anastomosis of the upper sigmoid to the rectum without proximal vent were performed. Rectal tube was passed through the anastomosis from below at operation. The postoperative course was marred by atelectasis and on the 12th day diarrhea became a troublesome complaint. The patient had an indwelling catheter postoperatively because of retention and attempts to remove this were fruitless and he was discharged with catheter in place. Also while in the hospital he showed some tenderness in the left calf which was interpreted as phlebothrombosis. This responded to heparin and dicumarol. Three months later these complaints had disappeared.

In the following case the patient developed a wound infection of such magnitude that his hospital stay was prolonged until the 29th postoperative day.

**CASE 16:** S. C., aged 75 years, male. After suitable preparation a closed resection and anastomosis with complementary appendicostomy were done. The patient responded well except for a temperature elevation to 102.6 on the second day. On the 4th day it was 103, despite this the patient was on surgical liquids and his bowels had moved twice. He continued to improve and his temperature elevation declined by lysis. On the 30th day a large abscess was found in the lower edge of the incision and drained. He was discharged on the 39th day.

The inclusion of this complication under wound infection rather than under localized peritonitis is open to question. The fact that ileus was not present in an unusual degree has persuaded us to classify this case as one of wound infection.

#### CARCINOMA OF THE RECTOSIGMOID

Resection of lesions in the rectosigmoid should rightly be considered as a separate group. This method of anterior resection and end to-end anastomosis was used in 8 cases. Six of these 8 procedures were performed in the last year of this 3 year report. The technique as advocated in recent years by Dixon was modified somewhat. In none of these cases was the pelvic peritoneum approximated over or about the anastomosis and in none was a presacral drain utilized. The technique used varied only in the type of anastomosis and whether or not use was made of a proximal vent as a complementary procedure.

In 5 cases resection and anastomosis were carried out in the aseptic manner with complementary appendicostomy or cecostomy. In the 3 remaining cases resection and anastomosis were by the open technique without a proximal vent. In all 3 of these cases a rectal tube was passed from below up through the anastomosis at the time of operation. This maneuver which has been described by Waugh and Custer and prior to them by Stone and McAnahan has also been very useful in our hands.

Complications in this group of 8 cases have been remarkably few. No evidence of peritonitis developed and fecal fistulas were notably absent. One patient Case 43 with carcinoma of the rectosigmoid who had an open type anastomosis without proximal vent with rectal tube through anastomosis, already described under phlebothrombosis, developed a troublesome diarrhea on the 12th postoperative day. In addition he had urinary retention and at one time in his early postoperative period he developed atelectasis. With treatment these complaints disappeared.

The only other complication was in Case 79 with carcinoma of the rectosigmoid. Operation was open anastomosis without proximal vent with a rectal tube through the anastomosis. This patient developed postoperative ileus which responded promptly to intubation. This case is described under intestinal obstruction.

These postoperative complications were not of a serious or lasting nature and the operative results have been good.

## SUMMARY AND CONCLUSIONS

In summarizing this report our attention is first directed to the 6 patients who died as a result of the operative procedure. There were 3 cases of coronary occlusion. Two of the 3 cases of occlusion occurred within a few hours after operation. Both of these patients came to operation with definite cardiac disease. Myocardial disease is not an uncommon finding in patients in this age group and every effort should be made to evaluate their cardiac status before operation. In every situation in which cardiac disease is present it is imperative that all precautions be taken to prevent embarrassment of the coronary circulation. A drop in blood pressure from whatever cause anesthesia or prolonged surgery should require the urgent attention of all concerned. Only in this way will this type of mortality be reduced. In all probability the third case of coronary occlusion occurred as a result of the undue strain put upon the heart by the stormy postoperative course. This must of course be considered a preventable death.

In the case of the 1 patient who died of small bowel obstruction we were guilty of an error in management. This patient died because the obstruction existed unrecognized for 12 hours.

One patient died of sepsis. This patient had remained at home with an obstruction for 3 weeks before admission. It is not easy to classify this as a preventable death. If there was an error it was probably due to the fact that a permanent type of colostomy was not done for decompression and perhaps a much longer time should have been allowed to lapse before definitive surgery was attempted.

The 1 case of peritonitis must of course be considered a technical failure.

Review of the statistics brings to light some very interesting facts. In comparing the two general types of anastomosis it is noteworthy that peritonitis was not evident in any of the 8 cases of open end-to-end anastomoses. Three cases of peritonitis occurred in the group of aseptic or closed anastomoses. Of the 4 cases in which the anastomosis failed to function 3 were in the closed and 1 in the open group. Open anastomosis as a routine procedure has been reported by some authors (1

18 19 20 31). In our small series conclusions are dangerous but speculations are certainly in order. Since these cases represent the surgical techniques of a group rather than an individual the speculations become even more justifiable. One explanation of our results is that all things being equal it will probably be conceded by most surgeons that a more exact suture can be placed in an open type of anastomosis than in a closed type.

The question of establishing a proximal vent or safety valve at the time of operation has always been a controversial one. As so often is the case in surgery, time modifies some of our most pronounced convictions. In 1931 in reviewing all of the colon cases in Peter Bent Brigham Hospital Cheever wrote "no surgeon of experience would advise as a routine primary resection with suture anastomosis in the distal colon without making a proximal safety valve. In the same article the author expressed doubt of the efficacy of a proximal vent in the right sided colon resections. Fourteen years later Wangenstein states (complemental) colostomy is not necessary and Vaughn and Custer. There is little question in our minds that colostomy is an unnecessary addition to resection performed for lesions of the sigmoid or above. However our feeling in regard to its use in lower lying lesions is not so definite. In that same year in their report on 173 cases of carcinoma of the colon Collier and Vaughn concluded that a complementary cecostomy is a wise safeguard in primary resection of the colon.

In our series complementary vents were established in 52 of the 83 resections. If we eliminate the postoperative complications which were remote from the operative site such as coronary occlusion and phlebotrombosis and carefully analyze the remaining 13 complicated cases we find the following facts. There were 6 cases in which a proximal vent as a complementary procedure was not established. In only 3 of these would a proximal vent have conceivably been of any benefit. In 2 of these 3 cases cecostomy was done with good result. In the third case the localized infection was at no time severe enough to warrant intervention. In the 7 cases in which



a proximal vent was established as a complementary procedure there were 3 in which the proximal vent was of obvious benefit.

In the light of these figures the following conclusions seem justifiable.

In low lesions a tube through the anastomosis seems to eliminate the necessity of a proximal vent.

In uncomplicated resections in which adequate lumen and undoubted blood supply to the parts are assured a proximal vent is an unnecessary maneuver.

In cases in which trouble develops at the suture line such as obstruction or leakage a proximal vent is a valuable adjunct but it seems reasonable to assume that such a vent could be established as the necessity arose rather than as a routine procedure.

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# PSEUDOCYSTS OF THE PANCREAS

## Report of 31 Cases

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EVER since 1761 when Morgagni first described the multiple cysts of the pancreas mesentery and omentum which be found in a cadaver the etiology diagnosis and treatment of pancreatic cysts has continued to be a challenging problem. Even such a basic prerequisite to the solution of this fascinating problem as an adequate pathological classification of pancreatic cysts has been impeded by difficulties which have not yet been overcome. The confusion in pathological terminology has resulted from disagreement regarding the origin and pathogenesis of the cysts.

Of all the pancreatic cysts the so called pseudocysts have been the most difficult to define properly. The term pseudocyst has usually been given to encysted fluid collections in the peripancreatic tissues of the lesser omental sac. The absence of an epithelial lining of the fibrous connective tissue wall of the pseudocyst has been used to differentiate it from true pancreatic cysts such as cystadenomas retention and proliferation cysts. But this differential criterion is not infallible and may lead to an erroneous pathological diagnosis. For example a large retention cyst may be indistinguishable from a pseudocyst if its epithelial lining should undergo pressure atrophy. Further it is possible that some pancreatic pseudocysts possess an epithelial lining which subsequently is destroyed by activated pancreatic enzymes or atrophies from pressure. Such possibilities as these make an accurate pathological diagnosis based upon the presence of an epithelial lining impossible in all pancreatic cysts.

Another intriguing aspect of pancreatic cysts is the observation that the pancreas is the only parenchymatous organ in the body

which reacts to trauma or inflammation by self destruction and the formation of a pseudocyst. Several reasons for this immediately suggest themselves. First its anatomical position astride the vertebral column makes it particularly vulnerable to blunt trauma. Second the pancreas responds to trauma or inflammation by pouring out large amounts of fluid which may or may not contain activated enzymes. The abundant blood supply of the pancreas and its ability to secrete approximately 800 cubic centimeters of pancreatic juice per day in the average adult seem to account for its profuse secretion when injured or inflamed. The presence of this irritating pancreatic secretion in the lesser omental sac appears to provoke a chemical peritonitis with a further outpouring of inflammatory fluid which eventually becomes encysted.

The most compelling phase of the problem of pancreatic pseudocysts is the surgical treatment. At present sharp differences of opinion exist regarding the employment of complete excision marsupialization or internal drainage of these cysts. The multiplicity of opinions as to the most desirable surgical procedure prompted us to review our experience with pseudocysts in an effort to evaluate the results of the procedures employed. From 1930 to 1947 inclusive 31 pseudocysts were operated upon at the Cook County Hospital and on the private service of one of us (K.A.M.). Pseudocysts which have been previously reported in the literature are found in Table I.

### ETIOLOGICAL FACTORS

A division of our 31 cases according to sex showed an equal distribution between male and female. 15 cases (48.4%) occurred in male patients while 16 cases (51.6%) occurred in female patients. This distribution differs from the experience of Rabinovitch and Pine-

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a proximal vent was established as a complementary procedure there were 3 in which the proximal vent was of obvious benefit.

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Another intriguing aspect of pancreatic cysts is the observation that the pancreas is the only parenchymatous organ in the body

which reacts to trauma or inflammation by self destruction and the formation of a pseudocyst. Several reasons for this immediately suggest themselves. First its anatomical position astride the vertebral column makes it particularly vulnerable to blunt trauma. Second the pancreas responds to trauma or inflammation by pouring out large amounts of fluid which may or may not contain activated enzymes. The abundant blood supply of the pancreas and its ability to secrete approximately 800 cubic centimeters of pancreatic juice per day in the average adult seem to account for its profuse secretion when injured or inflamed. The presence of this irritating pancreatic secretion in the lesser omental sac appears to provoke a chemical peritonitis with a further outpouring of inflammatory fluid which eventually becomes encysted.

The most compelling phase of the problem of pancreatic pseudocysts is the surgical treatment. At present sharp differences of opinion exist regarding the employment of complete excision marsupialization or internal drainage of these cysts. The multiplicity of opinions as to the most desirable surgical procedure prompted us to review our experience with pseudocysts in an effort to evaluate the results of the procedures employed. From 1930 to 1947 inclusive 31 pseudocysts were operated upon at the Cook County Hospital and on the private service of one of us (KAM). Pseudocysts which have been previously reported in the literature are found in Table I.

### ETIOLOGICAL FACTORS

A division of our 31 cases according to sex showed an equal distribution between male and female. 15 cases (48.4%) occurred in male patients while 16 cases (51.6%) occurred in female patients. This distribution differs from the experience of Rabinovitch and Pines

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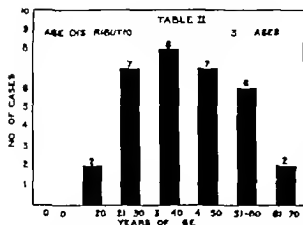


Chart Age distribution of 31 cases.

who found all of their 11 cases in female patients. This preponderance of female patients in their series may be explained by the fact that none of their patients suffered trauma, and the incidence of associated chronic cholecystitis and acute and chronic pancreatitis was high. These latter conditions are statistically more common in females.

The age distribution of the 31 cases is recorded in Chart 1. An analysis of the ages of the patients revealed a fairly even distribution between the ages of 20 and 60. The youngest patient was 14 years old and the oldest was 64 years old and the average age was 40.6 years. Telling and Dobson reported a pancreatic cyst in an 11 month old child. A congenital cyst of the pancreas without an epithelial lining was reported in a 5 month old infant by Eha.

A summary of the racial distribution revealed that 23 cases (74%) occurred in white patients while 8 cases (26%) occurred in negro patients. A survey of hospital admissions during these years showed that approximately the same proportion of white and colored patient admissions existed. Therefore no marked racial predilection was observed.

Blunt trauma to the pancreas, acute and chronic cholecystitis and acute and chronic pancreatitis are frequently associated with pseudocysts. Both clinical and experimental evidence is available which suggests that these factors are responsible for the production of pseudocysts. Lazarus experimentally produced a pseudocyst in a dog by crushing the

TABLE I—PSEUDOCYSTS PREVIOUSLY REPORTED

Author	Year	No. of cases
Lloyd	1892	
Koert	9	117*
Kerr	9 9	3
Judd	9	4
Lha	9	1
Emhorn	9 5	9
M. Whorter	9 5	6††
Imedential and Callen	926	
Judd, M. Ison, Mahorner	93	47
Gordin	937	
Meyer	939	3
Koosky, L. L.	94	4
Rabinovitch and Pines	949	
Chesterman	945	
Pinkham	945	
Adams and Nishijima	946	6
Carrier and Slattery	947	3

\*Collected from literature.

††Collected from members of Chicago Surgical Society.

pancreas. A hematoma formed which later became an encapsulated cyst containing 100 cubic centimeters of milky fluid.

In our series, a history of trauma was elicited in 16 (51.6%) of the 31 cases. Koert obtained a history of trauma in 33 (28%) out of 117 cases. Judd (17) noted trauma in only 1 of his 44 cases. More recently Pinkham stated that trauma occurs in 20 per cent, or less of cases. A possible explanation of the higher incidence of trauma in our series is the fact that our patients are drawn from an indigent population which is more prone to incur trauma. The time interval between the traumatic incident and the discovery of the pseudocyst averaged 5 months. The shortest time was 24 hours and the longest was 4 years. The trauma to the abdomen was severe in all cases and resulted from a variety of injuries such as kick in the abdomen, 4 automobile accident, 4 punch in abdomen, 5 fall on iron post, struck by baseball and not recorded each 1 case.

Cholecystitis and pancreatitis appeared to be etiological factors in 6 of our cases (16.4%). Cholelithiasis and chronic cholecystitis was found at surgery in 3 cases. In 1 case, acute cholecystitis was observed at surgery. A history suggestive of acute pancreatitis was obtained in 2 cases. The incidence of biliary and pancreatic disease was somewhat lower in our series than is reported by other authors. Adams and Nishijima reported cholelithiasis in 2 (40%) of their 5 cases. Pinkham reported



Fig. 1 Barium meal shows alteration of rugal pattern in pyloric region



Fig. 2 Anteroposterior roentgenogram shows the upward displacement of the pyloric region

6 cases (60%) out of 10 in which the pseudocyst was associated with pancreatitis and in 4 of these (40%) there was concurrent biliary tract disease. Judd (17) reported 17 (36%) out of 47 pancreatic cysts had biliary tract disease. Archibald (2) also noted the frequent association of biliary tract disease with bile pancreatitis and subsequent necrosis and pseudocyst formation. McWhorter reported 2 cases (33%) out of 6 in which the pseudocyst followed pancreatitis. From these data it is apparent that the etiological relationship of trauma, cholecystitis and pancreatitis to pseudocyst formation in our series coincides with the prevailing clinical impression on this point.

#### PATHOLOGY

The pathogenesis of pseudocysts as the discussion of their etiology has indicated is intimately related to trauma to the pancreas and to cholecystitis and pancreatitis. A consideration of the etiology of acute pancreatitis

and its relation to cholecystitis is not within the scope of this paper. For further information regarding this subject the reader is referred to the excellent papers of Opie, Archibald (2), Dragstedt, and Rich and Duff. Whatever the inciting agent may be the response of the pancreas to acinar damage is an escape and activation of trypsinogen and lipase with progressive focal necrosis and hemorrhage in the parenchyma of the gland. When this process of necrosis reaches the anterior surface of the gland it ruptures into the lesser omental sac where it produces a chemical peritonitis with a profuse inflammatory exudate from the adjacent serosal and peritoneal surfaces. If the foramen of Winslow is sealed off by this exudate the lesser omental sac is converted into a closed space within whose confines the exudate becomes encapsulated by the proliferation of fibrous connective tissue from the adjacent mesothelium lined surfaces during the reparative



Fig. 3. Oblique roentgenogram shows marked deformity of the posterior wall of the stomach and retrogastric radioopaque mass.

phase of the inflammatory process. The fibrous connective tissue which forms the cyst wall has numerous strands and dense adhesions to its parent surfaces, namely the structures which delimit the lesser omental sac. It is these adhesions which make complete excision of a large pseudocyst a difficult procedure. Carter and Slattery reported 2 cases in which the common duct was inadvertently opened during the excision of a pseudocyst. From the foregoing it is evident that the pathogenesis of pseudocysts is incumbent upon the response of the pancreas to injury by enzymatic autolysis and upon the location of the gland in a potentially closed space.

The position of the pseudocysts has been well described in previous papers. In our series the cyst presented itself through the gastrocolic omentum most frequently and through the gastrohepatic omentum less often. A retrogastric position of the cyst with the stomach pushed forward occurred with a fre-

quency equal to the gastrohepatic presentation. In one case the cyst presented itself through the gastrosplenic ligament, displacing the stomach anteriorly and to the right. In one instance the cyst presented in a retrogastric position causing the stomach to be tautly flattened over the cyst wall and producing pyloric obstruction. The excessive frequent vomiting which occurred in this patient plus a previous laparotomy scar on the upper abdomen led to the erroneous diagnosis of high intestinal obstruction.

The relation of the cyst to the various sectors of the anterior abdominal wall was as follows. In 2 cases the presence or absence of a mass was not recorded. In 3 of the remaining 29 cases (10.3%) no mass was palpated. In 12 (46%) of the 26 cases in which a mass was noted it was found in the left hypochondrium. The mass occupied the epigastrium next most frequently, being present there in 8 cases (31%). In no instance was the mass observed below the umbilicus. The mass appeared in the right hypochondrium in 1 case in the epigastrium and right hypochondrium in 2 cases in the epigastrium and left hypochondrium in 3 cases.

The amount of fluid contained in the cyst varied in the 16 cases in which it was measured. The smallest amount was 15 cubic centimeters and the largest 7,000 cubic centimeters. The average was 2,686 cubic centimeters. The color of the fluid was chocolate brown in 39 per cent, yellow or straw colored in 39 per cent, milky in 11 per cent, and hemorrhagic in 11 per cent. Pancreatic enzymes in the cyst fluid were tested for in 12 cases. In 9 of these (75%) enzymes were present and amylase, trypsin and lipase were found. Rahimovitch and Pines reported the presence of enzymes in 9 of their 11 cases. In the remaining 2 cases the tests were not performed.

#### X-RAY AND LABORATORY AIDS IN DIAGNOSIS

In the diagnosis of pseudocysts x-ray films proved far more useful in our hands than did laboratory tests. In the 8 cases in which scout films of the abdomen were taken a radioopaque mass was evident in 7. A barium meal was given in 14 cases and in 13 of these the



Fig. 4. Abdomen opened exposing the stomach displaced anteriorly by the retrogastric cyst

stomach was displaced (Figs. 1 to 3). In this regard it is interesting to note that Pinkham reported the use of gastric pneumograms to outline the pseudocyst. A barium enema was administered in 7 cases and the transverse colon was displaced in 6 of these.

Glycosuria was not detected in the routine urinalyses made in the 31 patients. The blood sugar level was determined in 6 cases and was found to be within normal limits.

A serum amylase determination was made in 8 cases. In 2 of these cases (25%) the amylase was elevated preoperatively to 124 and 96 units respectively. In both cases a ruptured cyst was found at operation. In 1 of these ruptured cysts one in which the pseudocyst followed an acute pancreatitis the serum amylase was elevated to 148 units on the fifteenth day after marsupialization. Pinkham noted an elevated preoperative serum amylase in 6 of his cases which dropped promptly after drainage in 4 cases. It is Pinkham's opinion that a sustained elevation of the serum amylase after acute pancreatitis is suggestive of the development of a pseudocyst.

#### SURGICAL TREATMENT

The first recorded attempt to treat a pancreatic cyst surgically was made by Le Dentu in 1862 (17). He punctured and drained the cyst but peritonitis developed subsequently and the patient died. Similarly Lucke (17) in 1866 drained a pancreatic cyst and the patient died. Not until 1861 when Bozeman (17)



Fig. 5. Cyst exposed by division of the gastrocolic omentum and dissected from the posterior surface of the stomach. Note the roughened area on the stomach with numerous vessels ligated where the cyst was adherent.

extirpated a pancreatic cyst was the first successful operation performed. Gussenbauer (17) a pupil of Billroth's in 1882 performed the first marsupialization of a cyst with success. Marsupialization was the only surgical procedure performed for pseudocysts until 1927 when Hahn anastomosed the cyst to the jejunum. In 1927 Walzel anastomosed the cyst to the gall bladder and ligated the cystic duct to prevent bile from entering the cyst. In 1931 Jurasz and Jedlicka each reported a case in which the pseudocyst had been anastomosed to the stomach. Judd, Matson and Mahorner (17) reported 47 cases in 1931. Seven of these cysts were completely excised, 33 were marsupialized, 6 were partly excised and drained, and 1 cyst was malignant and



Fig. 6. Further dissection of the cyst abandoned at this point because of dense adhesions to the middle colic artery.





Fig. 7. Cyst has been opened and aspirated revealing smooth lining without papillary growths.



Fig. 8. Cyst wall held with forceps while gauze pack is inserted.

inoperable. In 1935 Kirschner reported an anastomosis of a cyst to the duodenum. Neuffer in 1939 anastomosed a cyst to the gall bladder without ligating the cystic duct. One of us (KAM) (24) reported 13 cases in 1939 and in 3 of these the cyst was successfully anastomosed to the gall bladder the technique described by Neuffer being used. Pinkham in 1939 reported 10 pseudocysts all of which were marsupialized successfully.

More recently Chesterman in 1943 reported a successful anastomosis of a pseudocyst to the jejunum. In 1946 Adams and Nishijima reported 6 pseudocysts. Two of these were completely excised, 1 was anastomosed to the jejunum, 2 were drained externally and one was first drained externally and the fistula subsequently implanted into the jejunum. Carter and Slattery in 1947

reported 2 cases in which a pseudocyst was completely excised and a third case in which the cyst was anastomosed over a T tube to an accidental rent in the common duct.

In our series of 31 cases a total of 33 operative procedures were performed, one patient undergoing 3 procedures. The types of procedures which were employed are as follows: marsupialization, 25 cases; cystocholecystostomy, 4 cases; cystojejunostomy, 2 cases; complete excision, 2 cases.

#### RESULTS OF SURGICAL TREATMENT

The results of surgical treatment were analyzed from the standpoint of morbidity, metabolic disturbances and mortality. They will be discussed in that order.

**Morbidity.** In the 2 cases in which the cyst was completely excised the postoperative course was uneventful and the patients were discharged in 2 and 3 weeks respectively. These cases were considered satisfactory cures.

Cystocholecystostomy was performed in 4 cases of which 3 made an uneventful recovery. They had an average postoperative hospital stay of 18 days. Follow up studies were made on these 3 patients. One patient, a 64 year old female, died 1 month after operation of a cerebral hemorrhage. Examination of the cyst at autopsy revealed about 500 cubic centimeters of fluid still present in the cyst which originally contained 2000 cubic centimeters. The second patient who had recovered uneventfully was symptom free when seen 3 months later. A barium meal at this time



Fig. 9. Cyst marsupialized by suturing cyst wall, the peritoneum and posterior rectus sheath, A.

failed to demonstrate the cyst. The third patient in this group was readmitted 5 months later with abdominal pain tenderness and fever but no mass was apparent either on physical or roentgen examination. The patient refused further treatment after 2 weeks and left the hospital with residual tenderness and a low grade fever. The remaining case, one in which the cystocholecystostomy was performed after an unsuccessful marsupialization 3 weeks previously (Case 14 Table II), had a stormy postoperative course. The cyst drained poorly and remained palpable while the patient had a high fever and foul stools. Two weeks after cystocholecystostomy the cyst was marsupialized again.

The morbidity in the 2 cases where cystojejunostomy was performed was severe. One patient developed a fecal fistula on the tenth postoperative day and died 1 month later of sepsis and debility. The other patient ran a febrile course until he died, 10 weeks after surgery. Autopsy revealed a suppurative pancreatic pseudocyst with a purulent peritonitis and an early malignant cholangioma of the liver.

Marsupialization was associated with a moderate morbidity as evidenced by the summary in Table II. The average duration of the drainage in the 21 patients who survived the procedure was 7.2 weeks. One patient (Case 16 Table II) whose cyst had ruptured preoperatively developed a postoperative fecal fistula and the drainage persisted for 1 year.

That marsupialization is frequently the safest and most expedient procedure is illustrated by Figures 4 to 10 (retouched photographs). In this case (operated upon by Dr. Peter A. Rosi) complete excision was abandoned for marsupialization because of dense adhesions and adventitious blood vessels. The patient (Case 22 Table II) made an uneventful recovery.

**Metabolic disturbances.** No evidence of metabolic disturbance was noted in the cases in which the cyst was completely excised or anastomosed to the gall bladder. The deaths which occurred in cystojejunostomy were related to infection and overwhelming sepsis rather than to metabolic causes. That fluid,

TABLE II — RESULTS OF MARSUPIALIZATION

Patient	Discharged after surgery	Remarks
S. H.	Died on P. O.	Ruptured cyst
S. W.	5 weeks	Slight drainage
T. J.	4 months	Healed
J. O.	4 weeks	Poor drainage—slight residual mass
C. M.	0 weeks	Healed
L. O.	5 weeks	Slight drainage
F. L.	5 weeks	Slight drainage
O. H.	weeks	Healed
V. R.	weeks	Healed
F. S.	7 weeks	Healed
V. J.	3 weeks	Not recorded
D. G.	4 weeks	Slight drainage
V. B.	4 weeks	Slight drainage
J. N.	3 weeks	Fistula anastomosed to gall bladder
J. N.	4 weeks	Not recorded
L. G.	Died on P. O. 5	Ruptured cyst with peritonitis
J. S.	year	Ruptured cyst with post-operative fecal fistula
V. E.	weeks	Not recorded
E. K.	weeks	Slight drainage
V. P.	Died on P. O. 1	Postoperative massive telecystitis
L. L.	Died on P. O. 14	Ruptured cyst with peritonitis
E. R.	Died 4 months post-operative	Malignant cystadenoma
J. W.	4 weeks	Slight drainage
F. C.	3 weeks	Slight drainage
M. K.	4 weeks	Slight drainage

\*Cyst was marsupialized and then the fistula was anastomosed to the gall bladder and then marsupialized again.

electrolyte and nitrogen balance can be markedly disturbed in cases in which marsupialization has been performed is evidenced by Case 10 Table II. Detailed data regarding this case are presented to illustrate how profound these losses may be and what measures may be used to overcome them.

This patient was a 49 year old white female who had been struck in the abdomen during an altercation 10 days before her admission to the hospital on August 1, 1945. Following this blow she experienced epigastric pain and vomiting. The patient noted the development of a mass in the left hypochondrium which was verified on physical examination. The abdomen was tender and distended. The

TABLE III.—BLOOD CHEMICAL FINDINGS IN CASE 10

Date	Plasma vol	Hematocrit %	Total protein gm per 100 cc	Albumin gm per 100 cc	NP/N ratio per 100 cc	Bile salts mEq per L	Chloride mEq per L	CO <sub>2</sub> combining power per 100 cc	Urine per 24 hrs	Cyst drainage per 24 hrs	Kidney secretion gm per 24 hrs
Aug. 10	470	58	8.3	3.97	20	27	100	30	630	375	1.3
									630	300	1.5
									7500	300	23.2
3									2730	1000	23
4	508.5	51	8.66	3.24	22	44	108	58	1390	430	5
	508	46.5	8.7	3.5	28	5	108	60			

These data were previously published by Dr. W. S. Hoffman, in *Surgical Clinics of North America* February 1947, page 217.

red cell count was 3,700,000 and the leucocyte count was 14,500. The urine was scanty and concentrated. No preoperative x ray films were taken and the preoperative diagnosis was ruptured spleen. Operation was performed on the day of admission and a large pseudocyst was marsupialized.

Postoperatively a continuous suction apparatus was inserted into the marsupialized cyst to protect the abdominal wall and drainage from the cyst was collected. In spite of the daily administration of intravenous fluids on August 10 (10th postoperative day) there was an obvious hemococoncentration as evidenced by the low plasma volume and a low serum sodium due to the loss of a large amount of alkaline pancreatic fluid containing sodium bicarbonate. The sodium loss decreased the alkaline reserve and lowered the plasma carbon dioxide combining power resulting in a mild acidosis. The hemococoncentration and low plasma volume caused a retention of nonprotein nitrogen and a prerenal azotemia.

At this point, approximately 7000 cubic centimeters of 0.45 saline in 2.5 per cent dextrose were given during the next 3 days along with liquids and salt orally. On August 14 the plasma volume and serum sodium had been greatly restored by this therapy and in spite of profuse drainage from the cyst, a marked diuresis had been produced which resulted in the excretion of the previously retained nitrogen (Table III). The sodium replacement bolstered the alkaline reserve and elevated the carbon dioxide combining power. At this time with adequate hydration the decrease in total plasma protein became apparent and the patient was placed on low protein diet for 7 days to assay the minimal

protein requirements. Table IV shows the negative nitrogen balance during the period between August 14 and August 21 which was presumably due to the excretion of previously retained nonprotein nitrogen. On August 21 a high protein diet was initiated. After 14 days September 4 the plasma volume and the total circulating protein showed remarkable increments and a positive nitrogen balance was reestablished. The patient's clinical improvement closely paralleled the changes in the blood chemistry.

**Mortality.** The mortality rates are presented in Table V. No deaths occurred in the cases where complete excision or cystocholecystostomy was performed. A 100 per cent mortality rate was associated with cystojejunostomy because of infection in the cyst, leakage at the suture line, fecal fistula, and peritonitis. Four deaths occurred in the 23 cases in which the cyst was marsupialized with a mortality rate of 16 per cent. These cases have been divided into group A in which the cyst was unruptured preoperatively and group B in which the cyst had ruptured preoperatively and an emergency operation was performed. Of the 21 cases in the unruptured group (A) one surgical death occurred as a result of a massive postoperative atelectasis on the day after surgery (4.8 per cent mortality rate). One patient in this group died 4

TABLE IV.—EFFECT OF HIGH PROTEIN DIET ON CIRCULATING PROTEINS

Date	Diet	Initial Weight kgm	Weight gain kgm	Nitrogen balance gm	Hematocrit level %	Total protein gm per 100	Albumin gm per 100 cc	Plasma volume cc	Total circulating proteins gm	Total circulating albumin gm
Aug. 4	Control	4	—	—	6	6.05	3.44	508	130.6	50
Aug.	Low	—	6.3	7	8.5	6.7	65	508	33	17.9
Sept. 4	High	—	7	+2.5	20	6.3	4.3	568.5	230.5	121

These data were previously published by Kendall, D.D., Hoffman, W.S., Meyer, K.A. and Garret, T. in *Archives of Surgery*, 1946, 27, 621.

months after surgery and autopsy revealed a malignant cystadenoma. The 4 cases in the ruptured group (B) had a mortality rate of 75 per cent because of the associated peritonitis and shock.

#### DISCUSSION

As Archibald and Kaufman stated it is often impossible to distinguish between a pseudocyst and a true cyst. Since the principles of treatment of a true retention cyst do not differ from those of a pseudocyst accurate differentiation is not mandatory. However it is important to differentiate pseudocysts from proliferative cysts and cystadenomas which are neoplastic in character. To this end all pancreatic cysts should be opened after aspirating the contents and the interior and lining of the cyst carefully inspected. It is our opinion that these neoplastic cysts should be completely excised where technically possible. On the other hand Carter and Slattery have recommended marsupialization of proliferative cysts to permit destruction of the epithelial lining with radium or sclerosing agents.

The analysis of the mortality rates of the surgical procedures used suggests that complete excision might be the treatment of choice since the morbidity was negligible and no deaths resulted. However it should be pointed out that complete excision is usually feasible only in the smaller pseudocysts because the larger cysts are fixed by dense adhesions. Judd Mattson and Mahorner reported 7 cases in their series of 47 in which cysts ranging from 6 to 10 centimeters in diameter were completely excised. Carter and Slattery recommended complete excision of pseudocysts but in 2 of their cases an opening was inadequately made in the common duct during dissection of the dense adhesions and in a third case large adventitious blood vessels on the posterior wall of the cyst caused trouble some hemorrhage from the bed of the pancreas.

Although complete excision is usually reserved for smaller cysts even in these cases the procedure is not without some hazards. Trauma to the pancreas during the excision of the cyst may cause an acute pancreatitis or a pancreatic fistula. Maingot states the mor-

TABLE V — MORTALITY OF SURGICAL PROCEDURES

Type of operation	Number of cases	Deaths	Mortality per cent
Complete excision of cyst		0	
Cystocholecystostomy	4		
Cystojejunostomy			100
Marsupialization of a. Unruptured cyst		1	4.8
b. Ruptured cyst	4	3	75

\*These cases were published by John Koucky et al. Surg. Gyn. Obst., 64: 73, 1937.

tality rate of excision of a cyst ranges between 10 and 25 per cent if the cyst is successfully removed. A mortality rate of 55 per cent is given by the same author when an unsuccessful attempt at excision was made.

Cystocholecystostomy like complete excision had no immediate surgical mortality associated with it. But in spite of this several objections to this procedure present themselves. Incomplete emptying of the cyst was noted in 2 cases. In one of these cases the patient was reoperated upon and the cyst was marsupialized in the other case the patient died of a cerebral hemorrhage a month after surgery and at autopsy 500 cubic centimeters of bile and mucin were present in the cyst.

The failure of the cyst to empty completely is understandable when one considers that the cyst wall contains no smooth muscle and hence lacks contractile power. It is therefore dependent upon gravity for drainage. Incomplete emptying of the cyst leaves open the possibility of a traumatic rupture of the cyst with its attendant high mortality. A further objection to the creation of a large diverticulum of the biliary system by this procedure is the stasis of bile with activation of the enzyme lipase and subsequent fat necrosis. This last objection could be overcome as one of us (KAM 24) suggested in an earlier paper by using the technique of Walzel, in which a complementary ligation of the cystic duct is performed.

Since biliary tract disease is frequently associated with pseudocysts a Graham Cole gall bladder visualization should be performed to determine the function of the gall bladder in those cases in which a cystocholecystostomy is contemplated.

Cystojejunostomy was performed in 2 cases in this series with death occurring in both cases. Better results with this procedure were obtained by Adams and Nishijima who reported its successful employment in a pseudocyst and also in a papillary cystadenoma where it served as palliation. Follow up studies on these 2 patients 3 months later revealed them to be symptom free and when a barium meal was given, no barium entered either of the cysts. When a postoperative barium meal was given to one of our patients who ran a septic course after a cystojejunostomy the barium did enter the cyst. Subsequent autopsy of this patient showed a suppurative in the cyst and peritonitis. This evidence suggests that the creation of a large jejunal diverticulum into which food can pass and accumulate is potentially dangerous. An additional hazard in cystojejunostomy is leakage at the suture line which occurred in our second case and caused a fecal fistula and death from peritonitis. Finally the ability of enterokinase and bile to activate the pancreatic enzymes trypsinogen, chymotrypsinogen and lipase may cause acute pancreatitis, and fat necrosis.

Marsupialization in our series was performed with a low mortality rate (4.8%) in the unruptured cysts. This compares with the 7.6 per cent mortality reported by Babcock. One of the objections raised to marsupialization is the development of persistent fistulas which occur in 15 per cent of cases according to Babcock. In our cases the drainage persisted for an average of 7.2 weeks and no persistent fistulas developed in so far as the follow up study could ascertain.

A persistent fistula if it should develop may be treated by medical or surgical measures. Among the medical measures employed Comfort Osterberg and Priestley reported that ephedrine sulfate,  $\frac{1}{4}$  grain, given subcutaneously before a meal reduces the volume of secretion from a pancreatic fistula by 50 per cent. The concentration and total bicarbonate and total output of lipase were also reduced while amylase was not affected. They also noted that atropine sulfate  $\frac{1}{75}$  grain given subcutaneously before a meal reduces the volume of fistula secretion by reducing

gastric motility and secretion and thus indirectly decreasing the secretion liberated. Craft stated that ephedrine sulfate like epinephrine, decreased pancreatic secretion by its vasoconstrictive action on the pancreatic arterioles.

Other nonoperative measures in the treatment of a pancreatic fistula are based on the use of irritants to cause the proliferation of granulation tissue with eventual fibrosis of the fistulous tract. In this connection, Judd (16) stated that the absence of an epithelial lining in the cyst favored the formation of granulation tissue in response to irritants. Sodium morrhuate packs were placed in a marsupialized cyst by Gordin with complete healing in 18 days. Radium was used by Hamilton without marked improvement in the fistula. Roentgen therapy was used successfully by Culler in 2 cases of persistent fistula. Maingot states that if the fistula does not close within 6 weeks and most fistulas do tend to close spontaneously operation should be advised. The operative treatment of persistent fistula as reported by Lahey (17) is the transplantation of the fistula into the jejunum. Maingot states that this is a relatively safe surgical procedure as evidenced by the 3.8 per cent mortality in the 26 cases of pancreaticojejunostomy and pancreaticogastrostomy collected and reported by Lahey.

The postoperative care of a patient with a marsupialized cyst requires special attention to fluid, electrolyte and nitrogen balance. As Case 10 Table II illustrated the fluid and electrolyte loss may be so great as to produce a state of hemococoncentration with azotemia and acidosis. This may be accompanied by a profound protein loss and a negative nitrogen balance. The replacement of the fluids, electrolytes and protein with the re-establishment of a positive nitrogen balance indicates that these occasional complications can be successfully combated even when severe, if they are recognized early and treated vigorously. These postoperative measures have greatly reduced the hazards which formerly attended marsupialization in some instances. A further adjunct to postoperative care is the use of bronze or aluminum paste on the skin and continuous suction in the cyst to prevent the drainage fluid from excoriating the skin.

Ruptured pseudocysts have a mortality rate of 75 per cent largely because of the resulting peritonitis and shock. This alarming mortality rate emphasizes the importance of early elective surgical intervention in pancreatic pseudocysts to preclude the possibility of rupture of the cyst.

#### SUMMARY

1 A report is given of 31 cases of pseudocysts of the pancreas which were treated surgically

2 Severe blunt abdominal trauma was an etiological factor in 51.6 per cent of cases cholecystitis cholelithiasis, and pancreatitis were factors in 16.1 per cent of cases

3 The amount of fluid found in the cysts ranged between 15 and 7000 cubic centimeters and averaged 2686 cubic centimeters

4 In 13 of 14 cases in which a barium meal was given displacement of the stomach was shown and in 6 of 7 cases in which a barium enema was given displacement of the transverse colon was shown where these procedures were utilized.

5 Complete excision of a small pseudocyst was done in 2 patients without a mortality. Cystocholecystostomy was performed in 4 patients without a mortality. Marsupialization was performed in 21 unruptured cysts with a mortality rate of 4.8 per cent and in 4 ruptured cysts with a 75 per cent mortality rate. Cystojejunostomy was performed in 2 cases with a 100 per cent mortality rate

6 Following marsupialization in 1 patient, profuse drainage from the cyst caused hemocoagulation mild acidosis azotemia and a negative nitrogen balance. Energetic administration of fluid electrolytes and a high protein diet corrected these complications

7 The average duration of drainage from the cysts following marsupialization was 7.2 weeks and, in no instance did a persistent fistula develop

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# ENDOMETRIOSIS—ITS SURGICAL SIGNIFICANCE

## A Critical Analysis of 179 Cases

FRANCIS J. KELLY M.D., Amarillo, Texas, and K. RAMSAY SCHLADEMAN M.D. Fort Wayne, Indiana

**E**NDOMETRIOSIS is generally considered to be a lesion containing ectopic uterine mucosa.

Many authors recently have confined their remarks to the extrauterine manifestation and for this reason it was felt worth while to study the problem in its entirety rather than limit our considerations. Though cognizant of the very probable difference in origin of the two types (intrauterine and extrauterine) we were especially interested in two factors which could be affected by endometriosis regardless of location. One is the too frequently emphasized symptom of progressive dysmenorrhea and the second is the incidence of absolute fertility following conservative surgical management as determined by careful follow up study.

In 1896 von Recklinghausen enunciated his theory of misplaced derivatives of the wolffian or muellerian duct, which might explain the presence of ectopic endometrium. Cullen's monumental work in 1908 followed, but it was not until 1921 subsequent to the excellent study of Sampson (15) that the lesion became of widespread clinical significance. At the present time there remain many theories concerning the origin of endometriosis, no one adequately explaining the diverse manifestations. It is increasingly evident that the disease may be due to several factors. The most widely accepted suppositions include the following:

1. The embryonic theory oldest of all is based on the fact that the epithelium of the pelvic peritoneum fallopian tubes uterus and germinal epithelium of the ovary have a common origin in the celomic epithelium and under certain conditions the embryonic rests

contained in the pelvic peritoneum reproduce endometrium.

2. The metaplasia theory attempts to explain endometriosis by holding that the peritoneum is stimulated to form glands resembling endometrium. The greatest objection to this very convenient explanation is the necessity of assuming metaplasia.

3. Sampson's (16) view and perhaps the most widely known postulates that endometrial cells escape by way of the fallopian tubes, at menstruation and are deposited on the ovary or pelvic peritoneum and develop as an implant. The chief objection to this theory is its failure to explain extraperitoneal lesions, in the bladder inguinal glands, or as seen from 1 case in this series, in the umbilicus.

4. Recently there has been renewed interest in lymphatic transportation as advanced by Halban in 1924. Sampson (17) in 1927 demonstrated endometrial fragments in the veins of the uterus.

5. Finally surgical implants are occasionally seen following pelvic operations and one such instance is reported in the present series.

### MATERIAL

During 1,991 consecutive abdominal gynecologic operations at Scott and White Clinic, 179 (8.9 per cent) histologically verified cases of endometriosis were found and these together with follow up study form the basis for this paper. The average age of these patients was 38 years the youngest 20 and the oldest 65 years.

Fallas and Rosenblum report 1.62 per cent endometriosis in 15,975 gynecologic laparotomies done in two Los Angeles private hospitals between 1930 and 1939. Sanders encountered the lesion in 17 per cent of 700 laparotomies for gynecologic diseases. Meigs (12) on the other hand found that 28 per cent

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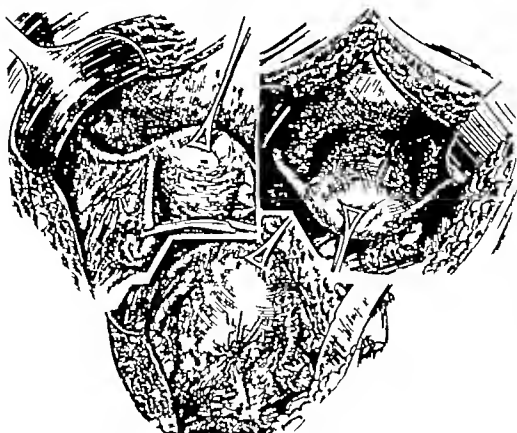


Fig. 2 Multiple sites of implantation as seen at operation. Note typical puckering and dense, solid strands.

of 400 private patients and 5.8 per cent of 400 patients at the Massachusetts General Hospital showed extrauterine endometriosis microscopically. It is difficult to determine the incidence of endometriosis as many of the tumors are small and easily overlooked in routine examinations due to the multiplicity of sites of invasion (Fig. 1). The serious consequences of the unrecognized tumor requires no elaboration and it becomes imperative for the surgeon to search carefully and to recognize the characteristic bluish black dots on the pelvic peritoneum.

#### APPEARANCE

Endometriosis presents a rather typical gross appearance best referred to as 'puckered' areas especially in the advanced stages. Early manifestations are likewise characteristic in their 'blueberry spot' form. When these cysts perforate or are ruptured, a black, tarry irritating fluid may be scattered over the contiguous organs. Just as the cysts react to ovarian stimulation at the menstrual phases much the same as normally situated endo-

metrium so at the menopause whether natural or artificial, endometrial lesions will recede.

The presence of adhesions due to endometriosis are frequent and when once seen should rarely be confused with those caused by other pelvic inflammatory disease. The adhesions of the latter are generally broad and labile and easily torn while those of the former are tough and solid with a tendency to strand formation. Fixed retroversion of the uterus should always cause the surgeon to suspect endometriosis. Chocolate cysts of the ovary are less likely to be overlooked however we believe that it is imperative that a microscopic section be performed at once if radical surgery is contemplated to exclude simple hemorrhagic cysts.

#### PATHOLOGY

The microscopic picture of extrauterine endometriosis is that of well defined endometrial glands surrounded by endometrial stroma varying in amount from little or none to a definitely stromal collar. Those implants influenced by hormones contain extravasated blood and hemosiderin laden phagocytes.



TABLE I.—SYMPTOMATOLOGY

	No. of cases	Percentage
Acquired dysmenorrhea	86	43.2
Severe	24	
Moderate	37	
Mild	25	
Increasing dysmenorrhea	60	33.5
Menorrhagia	43	25.1
Low backache	31	7.3
None	25	3.9
Headache	8	
Nervousness	7	
Gastrointestinal disturbance	6	
Dyspareunia	15	
Irregular periods	5	
Metrorrhagia	3	
Abdominal mass	11	
Referred pain	6	
Rectum	2	
Stomach	1	
Thigh		
L.L.Q.		
R.L.Q.		
Urinary frequency	6	
Menopause	6	
Weakness		
Premenstrual discomfort		
Painful scar with menstruation		

The microscopic picture of intramural endometriosis or adenomyosis consists of well defined epithelial islets surrounded by varying amounts of stroma within the myometrium. Serial study of such implants will show them to be continuous with the endometrium and the formation is that of a crypt like structure extending into the myometrium (1-13). The adenomyoma of Cullen is a variant of intramural endometriosis in which the epithelial implants are incorporated in a leiomyoma.

The diagnosis of adenomyosis in this series was based on the finding of endometrial inclusions in the myometrium a distance of at least the diameter of a full low power field from the base of the endometrial lining of the uterine cavity. Serial study would undoubtedly have shown these areas to be distal prolongations of cryptic invaginations from the endometrium.

#### SYMPTOMATOLOGY

The clinical diagnosis is admittedly difficult because of the variable history symptoms, and physical findings. There is one symptom however toward which particular attention was directed in this review. This is the factor of increasing or progressive dysmenorrhea. Though King and Fiddes in 1929 pointed out

this symptom as being characteristic, the majority of writers on this subject, we feel, do not emphasize this factor sufficiently. We agree with Fallon, Broanan and Moran that, when present, the symptom should be considered pathognomonic. In a review of 200 articles, these authors found only 12 who emphasized this symptom.

As noted in Table I, 1 out of 3 patients complained of increasing dysmenorrhea. This takes on added significance when it is noted that only 48.2 per cent complained of the repeatedly emphasized symptom of acquired dysmenorrhea, which, though important is part of the symptom complex of many disorders of the female genital organs. The distinction is important and should not be confused.

With a complaint of painful periods it should be determined whether or not the dysmenorrhea has been present since menarche or has been acquired following normal menstrual cycles. In most cases of endometriosis the latter situation will have prevailed. If the patient further states that her dysmenorrhea, acquired or not, has progressively become more intense with each succeeding cycle the diagnosis rests with endometriosis. We know of no other condition in which this symptom is present. The rate of progression is variable and many patients take several years before the severity increases sufficiently to bring them to their physician. On the other hand, the patient may have had painless periods for years may develop dysmenorrhea which becomes more intense with each succeeding period, and may require treatment within a very few months from the initial onset. Too the length of time the patient may complain of pain during each period will vary though as a rule the longer the duration of progression the more extended will be the dysmenorrhea at any particular period. In several instances patients were without pain for only a few days in each complete cycle.

One out of 4 complained of an increased amount of flow at the menstrual period. Low backache was a relatively frequent complaint during menses, though in no appreciably greater incidence than that found in the average female with pelvic complaints. Twenty

TABLE II — CLINICAL DIAGNOSES

	No. of cases	Percentage
Uterine displacement	131	73.2
Uterine leiomyoma	90	50.3
Adhesions	45	25.1
Ovarian cyst	39	21.8
Endometriosis	26	14.5
Pelvic inflammatory disease	21	11.7
Psychoneurosis	8	4.5
Appendicitis, recurrent	7	
Ectopic pregnancy	2	
Essential dysmenorrhea	2	
Menopause	2	
Cancer of uterus	2	
Cystitis, duodenal ulcer, urethritis, cancer of sigmoid, urachal cyst, intestinal obstruction, pyometritis, incarcerated omentum	1 each	

five patients on the other hand gave no symptom referable to menstruation.

Thirty-two patients (17.9 per cent) had lesions of the rectosigmoid (Fig. 2) but only one half of these gave a history of gastrointestinal disturbance. One of these however had a partial intestinal obstruction while the remainder complained of painful defecation, abdominal distention or flatulence immediately prior to or during the menstrual period. Masson found endometriosis of the sigmoid and rectovaginal septum in 34 of 576 cases or in 5.9 per cent while Sanders found that 12 per cent had involvement of the sigmoid.

Dyspareunia was a complaint of 15 patients and this of course must be considered in the high rate of relative sterility in this group of patients.

#### DIAGNOSIS

It is a regrettable fact that endometriosis in spite of its prevalence and importance has a low diagnostic index. In this series the diagnosis was correctly made in 14.5 per cent. In this connection it is to be noted that had the symptom of increasing dysmenorrhea been regarded as indicative of endometriosis as we now believe it should be, the diagnostic index would have more than doubled to 33.5 per cent—the percentage of patients with this complaint. Uterine displacement (prolapse, retrocession, retroversion) is a common finding in the presence of endometriosis, often due to the inflammatory reaction and subsequent adhesions induced by the peritoneal implants. A fixed retroversion should at once cause the



Fig. 2. Characteristic appearance of endometriosis on the sigmoid. The uterus has been removed.

physician to consider endometriosis. A summary of the clinical diagnoses made in this series is presented in Table II.

#### LOCATION OF ENDOMETRIOSIS

Endometriosis is extremely rare above the umbilicus. In this series 1 endometrioma was found in the umbilicus. The distribution of the lesions follows that found in most large series (Table III). The peritoneal surface of the uterus was the most common site, the lesion being present in 64 patients. The wall of the uterus was next in frequency, with 46 patients having diffuse adenomyosis and 11 found to have intrauterine endometriomas. The cul-de-sac was involved in 42 patients and in most cases the result was a marked retrodisplacement. Situations where heterotopic endometrium was found in the group of patients included in this study are consolidated on the illustration in Figure 3.

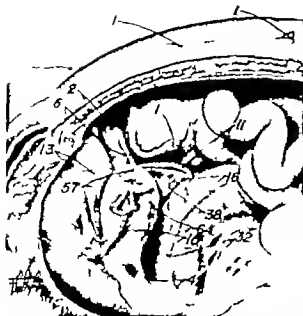


Fig. 3. Distribution of ectopic endometrial mucosa in this series. The arrow indicates the sites of invasion. The figures indicate the number of cases in which the lesion was found in each location (Table III).

In 1 patient the lesion was found in a laparotomy wound. Keene and Kimbrough found 1 in this location in a series of 118 cases while Jenkinson and Brown reported 3 in 117 cases. In our group 81 patients had been subjected to a previous abdominal gynecologic operation. It is evident then that manipulation or trauma of the pelvic organs at the time of surgery can be a direct etiologic factor in the spread of endometriosis. That the original production of endometriosis can be influenced by manipulative procedures must be considered for in this series a relatively large number of patients had undergone previous surgery (45.3 per cent). The average number of years since that surgery was 8.4 years.

#### ASSOCIATED PELVIC CONDITIONS

A characteristic feature of endometriosis is the frequent occurrence of pathological conditions in association with the lesion. Displacement of the uterus was relatively common particularly retroversion (Table IV). One hundred and forty-eight patients had some type of displacement not considered normal. Leiomyoma occurred in 88 (49.4 per cent) of 178 patients (1 previous hysterecto-

TABLE III—LOCATION OF ENDOMETRIOSIS

Surface of lesion	No. of cases
Mural	64
Diffuse	57
Endometrioma	46
Cul de sac	1
Surface of ovary	42
Rectosigmoid	38
"Chocolate" cyst of ovary	3
Surface of bladder	6
Fallopian tube	3
Broad ligament	
Round ligament	6
Parietal peritoneum	2
Appendix	
Umbilicus	
Abdominal scar	

my). Counseller reported 54.5 per cent of 308 patients and Keene and Kimbrough found 55.4 per cent with myoma. Two patients in our group had endometriosis concomitant with adenocarcinoma of the uterus. An interesting finding in view of the relative sterility of the patient with endometriosis was 1 patient in whom the lesion was found during surgery for tubal pregnancy.

#### SURGICAL PROCEDURES

The choice as to the correct type of operation to be employed is not always clearly defined. The extent and location of the lesions are of primary consideration though the age of the patient is a factor especially in those over 40 years. The problem however will always be present as endometriosis is not a disease of old age but rather a disease affecting a large percentage of women during their reproductive life. Most surgeons are in agreement with the statement that it is well worth while to spend 30 minutes or more if necessary excising individual lesions than to perform the more radical procedures. That this conservatism when possible will bear fruit will be shown later (Table VI).

In our series it was necessary to do the more radical procedures in 132 patients. One hundred and thirty of these required hysterectomy (72.6 per cent) while the remaining 2 patients were treated by bilateral oophorectomy alone.

As might be expected with these lesions, lysis of adhesions of more than minor nature was performed in a relatively large number of cases (36.9 per cent). It is not surprising then

TABLE IV — OPERATIVE FINDINGS

	N of cases	Percentage
Displacement of uterus		
Retroversion (with or without prolapse)	92	51.4
Prolapse and (or) retrocession	54	30.3
Anterior	14	
Suspension	3	
Antiflexion	2	
Previous hysterectomy	1	
Not known	13	
Associated pelvic disease		
Fibromyoma	88	49.4
Adhesions	75	
Chronic salpingitis	41	
Ovarian cortical fibroma	8	
Atrophy of tube and ovary	5	
Adenocarcinoma of uterus	2	
Tubal pregnancy	1	
Cysts of ovary		
Follicular	97	
Hemorrhagic	68	
Corpus luteum	15	
Hemorrhagic cystadenoma	6	
Dermoid	1	

to find that of the 48 patients in whom hysterectomy had not been performed all but 1 required uterine suspension (Table V)

No patient received presacral resection though occasionally considered as the experience at this clinic has been that surgical replacement of the uterus has satisfactorily relieved the symptoms arising from displacement

#### FERTILITY

Perhaps the most important factor in a discussion of endometriosis is its relation to fertility both prior to and following surgery. This is of special consideration to the patient in the child bearing age. If conservative surgery is to be practiced what chance will the patient have of becoming pregnant following conservation of the reproductive organs? We believe it is sufficient to warrant the plea to err on the side of conservatism rather than to employ specific treatment and destroy ovarian function at the time of surgery.

If symptoms persist the diagnosis having been made roentgen therapy may then be applied to one or both ovaries. In our series this has been necessary in 7 patients with relief of symptoms in all cases.

Most observers conclude that 10 to 15 per cent of marriages do not result in pregnancy. Reynolds and Macomber stated that the per

TABLE V — MAJOR OPERATIVE PROCEDURES

	N of cases	Percentage
Hysterectomy	130	72.6
Hystero-oophorectomy	113	
Supracervical	15	
Total	2	
Free adhesion	66	36.9
Uterine suspension	47	26.3
Unilateral oophorectomy	26	14.5
Bilateral oophorectomy	2	
Excision of umbilicus	1	
Release of obstruction	1	

centage of sterile marriages in Massachusetts was not lower than 10 and probably not higher than 13 per cent. In this study we have used the figure of 88 per cent as representing normal fertility.

Under the heading of absolute fertility are included only those patients who had actually been pregnant prior to surgery. Those patients however married less than an arbitrary 5 year period prior to treatment were excluded. Thus it was determined that of 166 patients only 46.4 per cent had ever become pregnant. Jeakinson and Brown found 41 per cent had been pregnant. Keene and Kimbrough reported 59.1 per cent while Meigs (12) found 65.7 per cent fertility.

The relationship between endometriosis and delayed or infrequent childbearing is well known. Cause and effect however have yet to be adequately defined. Certainly as Meigs (11) has stated women with a stigma of underdevelopment (and many of these do not marry because they are also underdeveloped sexually) and well developed women who put off marriage too long or who try to put off pregnancy until well after married life has begun are likely to develop endometriosis. On the other hand the presence of endometriosis may result in marked retroversion, dyspareunia, pelvic inflammation and intrauterine endometrioma which in themselves are not

TABLE VI — RELATION OF ENDOMETRIOSIS TO PREGNANCY

Average age (all patients)	38 years
Normal fertility	88 per cent
Absolute fertility in this series (excluding those married less than 5 years)	46.4 per cent
No. of patients relatively fertile following surgery	38
Average age	31 years
Absolute fertility (following surgery) 166 patients.	23.7 per cent

Infrequent causes of relative sterility. Of the 166 patients who had been pregnant prior to surgery the average interval between their last pregnancy and the time of operation was 11 years. Keene and Kimbrough reported the average interval of sterility in 39 patients was 9.5 years.

Following surgery 38 patients in this study could be classed as relatively fertile; that is, pregnancy was both theoretically and practically possible as far as could be determined. The average age of this group of patients was 31 years. It has been possible to follow these patients a minimum of 2 years and a maximum to date of 6 years. Though a longer follow up interval would be desirable, the results during this time serve to re-emphasize the value of conservative surgery whenever possible. Eleven pregnancies have occurred in 23.7 per cent of these 38 patients and all occurred within 4 years following surgery. Two patients have been pregnant twice during this time, neither of whom had previously been pregnant.

#### SUMMARY

1. A brief résumé of the most widely accepted hypotheses concerning the etiology of endometriosis is presented. It is evident that no one theory adequately explains the variable manifestations.

2. Endometriosis was present in 8.9 per cent of 1991 consecutive gynecologic laparotomies.

3. Progressive dysmenorrhea, when present is pathognomonic of endometriosis. If more

attention were directed toward this symptom the low diagnostic index now prevalent could be appreciably raised.

4. Though radical operative procedures were considered necessary in the majority of these patients, conservatism when possible is justified as indicated by an absolute fertility of 23.7 per cent after conservative surgery had been carried out.

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# THE ETIOLOGY OF STRESS INCONTINENCE

S RICHARD MUELLNER, M.D., Boston Massachusetts

THE precise etiology of exertional incontinence has to date remained obscure. Opinions are still divided on the nature of the lesion responsible for the impaired urinary control. Most authors ascribe stress incontinence to traumatized urethral sphincters as a result of childbirth, others insist that it is caused by obstetrical injury of the bladder supports.

In a previous investigation (4) 95 patients with exertional incontinence and 45 continent multiparas were carefully studied by cystometry, cystoscopy, cystography and urethrography.

These studies failed to reveal a specific lesion of stress incontinence, but made it clear that unless much more was known about the normal mechanism responsible for urinary control, the cause of exertional incontinence could not be detected. Specifically, one had to know how a normal woman initiated and shut off her urinary stream.

This information could not be obtained by cystometry or cystography and urethrography. It was therefore necessary to devise a technique of study which could portray the dynamic events of micturition.

Direct observation of the bladder under the fluoroscope seemed to offer such a possibility and for the past year and a half a study of normal and abnormal micturition in men, women and children was carried out at the Beth Israel Hospital (5). A total of 85 observations have been made to date, 30 of these were of women suffering from stress incontinence.

The technique of study was briefly as follows. The bladder was first filled through a No. 16 French catheter with a contrast medium consisting of a 5 per cent (5%) solution of sodium iodide to which a 20 cubic centimeter ampule of aqueous diodrast (35% by volume) had been added. The catheter was then withdrawn. A filling of the bladder with 200 to 250 cubic centimeters of this mixture was usually sufficient for study in the average case.

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Observations were made with the subject supine, standing, and turned to one side or the other. Care was taken to maintain the relationship of the x-ray tube to the symphysis pubis so that changes in the position of the bladder resulting from a change of posture could be accurately evaluated.

The effects of coughing and straining on the bladder and on its supports and the events at the beginning of micturition and when the urinary stream was inhibited were then carefully observed. Spot films of the bladder while the patient was in various positions and during micturition were taken from time to time.

A special plastic urinal (Fig. 1) which would not cast an x-ray shadow was devised to permit the subject to void while standing.

The precise pathology of exertional incontinence became apparent when the findings in the normal nullipara and in the continent multipara were compared with the observations in women with stress incontinence.



Fig. 1. Plastic urinal. Note long handle.

infrequent causes of relative sterility. Of the 166 patients who had been pregnant prior to surgery the average interval between their last pregnancy and the time of operation was 11 years. Keene and Kimbrough reported the average interval of sterility in 39 patients was 9.5 years.

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This information could not be obtained by cystometry or cystography and urethrography. It was therefore necessary to devise a technique of study which could portray the dynamic events of micturition.

Direct observation of the bladder under the fluoroscope seemed to offer such a possibility, and for the past year and a half a study of normal and abnormal micturition in men, women, and children was carried out at the Beth Israel Hospital (5). A total of 85 observations have been made to date; 30 of these were of women suffering from stress incontinence.

The technique of study was briefly as follows. The bladder was first filled through a No. 16 French catheter with a contrast medium consisting of a 5 per cent (5%) solution of sodium iodide to which a 20 cubic centimeter ampule of aqueous diodrast (35% by volume) had been added. The catheter was then withdrawn. A filling of the bladder with 200 to 250 cubic centimeters of this mixture was usually sufficient for study in the average case.

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Observations were made with the subject supine, standing, and turned to one side or the other. Care was taken to maintain the relationship of the x-ray tube to the symphysis pubis so that changes in the position of the bladder resulting from a change of posture could be accurately evaluated.

The effects of coughing and straining on the bladder and on its supports and the events at the beginning of micturition and when the urinary stream was inhibited were then carefully observed. Spot films of the bladder while the patient was in various positions and during micturition were taken from time to time.

A special plastic urinal (Fig. 1) which would not cast an x-ray shadow was devised to permit the subject to void while standing.

The precise pathology of exertional incontinence became apparent when the findings in the normal nullipara and in the continent multipara were compared with the observations in women with stress incontinence.



Fig. 1. Plastic urinal. Note long handle.





Fig. 2. a, C. M. Nullipara, Recumbent note shape of the bladder base and its position in relation to symphysis pubis. b, Erect note that bladder position is maintained in erect posture. c, During micturition the vertical diameter of the bladder is increased, and the horizontal diameter has decreased. The internal sphincter occupies a somewhat lower position in the pelvis.

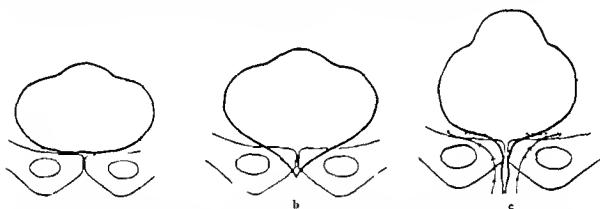


Fig. 3. a, Diagram of bladder in nullipara. Dotted line shows change of bladder shape on coughing. Note that bladder base remains steady. b, Note "pointed" appearance of bladder base and descent of internal sphincter with voluntary attempt at micturition. c, Voluntary inhibition of the urinary stream. Arrows point to the direction in which the bladder base is lifted. p, Urinary stream off. Dotted line shows bladder shape when urinary stream is stopped.

In the normal nullipara while recumbent the bladder has a smooth outline and its base lies just above the symphysis pubis (Fig. 2a). This position of the bladder is maintained when she stands up. On coughing the bladder base does not yield but the impulse from the increased intra abdominal pressure is dissipated along the dome and to the sides of the bladder revealing the excellence of the bladder supports (Fig. 3a).

When she is asked to void the bladder base can be seen to descend sharply so that the region of the internal sphincter becomes the most dependent portion of the bladder and assumes a "pointed" appearance (Fig. 3b). This is the first important maneuver in the complex process of micturition and its significance was

neither known nor appreciated in the past. It is this descent of the internal sphincter which opens it slightly and permits a small amount of the contrast medium to enter the proximal urethra. This is followed by contraction of the detrusor and uninterrupted micturition then ensues. Once micturition has begun the bladder base returns to a position slightly lower than that of its resting phase (Fig. 2c).

If the subject is now asked to inhibit the urinary stream she pulls the bladder base up quickly and to a level slightly higher than it had assumed before micturition. The bladder base becomes horizontal and the urinary stream is promptly shut off (Fig. 3c).

In the continent multipara the events are very similar except that the bladder is some



Fig 4. a left R.G. continent multipara, recumbent. b, Erect note descent of bladder base, indicating laxity of general bladder supports, yet not causing stress incontinence.

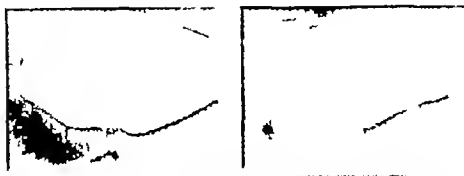


Fig 5. a left, A.H. multipara, stress incontinence. Recumbent note position and shape of bladder base. b Erect note 'pointing' of bladder base. Internal sphincter has descended. Pointed bladder base is typical of stress incontinence.

what larger and flabbier and the bladder supports are more yielding. The bladder base sinks to a considerably lower position in the standing as compared to the recumbent posture (Fig 4a and b).

On coughing or straining the bladder base descends as a whole with the sudden increase in intra abdominal pressure. These women clearly demonstrate that mere relaxation of the bladder supports does not impair urinary control.

A few points in the observations of women who can control the urine deserve emphasis.

First the bladder base and especially the region of the internal sphincter is in close relationship to the muscles of the pelvic floor. Second these muscles play a very active part in the initiation and in the inhibition of the urinary stream. Third when the continent woman stands up these muscles form a firm support for the internal sphincter and not only take on the added gravitational strain induced by the erect posture which amounts to

10 to 12 millimeters of mercury (6) but they also take up any additional sharp increases in intravesical pressure which result from exertion coughing or sneezing and thus protect the internal sphincter against these stresses.

A review of the anatomy of the muscles of the pelvic floor and especially the contributions made by Thompson, Savage, Holl, Lesshaft and Smith make it clear that it is the pubococcygeus portion of the levator ani and perhaps to a very much lesser extent the deep transverse perineal muscle which play this important part in micturition and in urinary control. These muscles with a somatic innervation are responsible for the descent of the internal sphincter at the start of micturition and they sharply lift the bladder base up to shut the stream off. It is the descent and the opening of the internal sphincter which initiates the reflexes of micturition.

Under the fluoroscope the descent and the 'pointing' of the internal sphincter appear as a downward pull. Actually there are no mus-

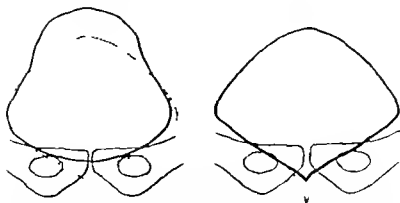


Fig. 6. a, left, Diagrammatic representation. Stress incontinence. Solid line, bladder during recumbency. Dotted line, "pointing" of bladder base and descent of internal sphincter when erect. b, Solid line, bladder during erect posture. Dotted line showing minimum descent of internal sphincter which is necessary for micturition.



Fig. 7. a, left, L. G. primipara, life-long stress incontinence unaffected by birth of child. Recumbent, note smooth bladder base above symphysis. The internal sphincter is normally shut off. b, Erect, not straining, note "pointing" of bladder base and "funneling" of internal sphincter revealing its congenital callosity.

cles in the pelvic floor or in the perineum which could pull the bladder base down. It is more correct to speak of this maneuver as a 'downward push' and it is brought about by the joint forces resulting from the increased intra-abdominal pressure (the fixation of the diaphragm at the end of a brief inspiration and the contraction of the abdominal muscles), gravity and the relaxation of the muscles of the pelvic floor (3).

In contrast to animals, only erect man has a pelvic outlet which is constructed to cope with the problem of gravity resulting from postural changes.

Erect man thus has a dual mechanism for urinary control. First there is the internal sphincter which in tonic contraction while the detrusor is relaxed effectively shuts the blad-

der off and second the muscles of the pelvic floor. For urinary control in the female the distal two-thirds of the urethra are of no consequence since this much of the urethra can be excised as it usually is for carcinoma of the urethra, without in any way impairing urinary continence (2, 10).

If these important facts are kept in mind the lesion of exertional incontinence becomes at once apparent.

While recumbent women with stress incontinence have a bladder shape very much like that of the continent multipara. On coughing the bladder base makes a considerable excursion downward but the region of the internal sphincter takes up most of this downward thrust and yields even more than the base.



Fig 8 a, left S G nullipara, life-long stress incontinence. Recumbent note smooth bladder base. Internal sphincter shut off normally b Erect as row points to 'funneling' of internal sphincter

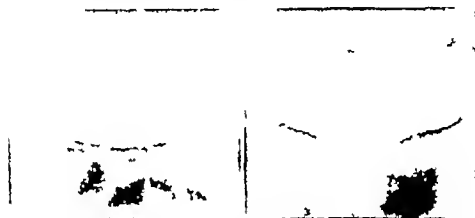


Fig 9 a, left, S H., nullipara who developed stress incontinence after a recent hysterectomy. Recumbent note smooth bladder base. Internal sphincter is normally shut off b, Erect note pointed bladder base and descent of internal sphincter

While lying quietly the internal sphincter is shut off normally showing no evidence of injury or deficiency (Fig 5). When the patient is now made to stand up the bladder assumes an appearance which has been present in every case of incontinence studied by means of this technique and one which can therefore be said to be typical of stress incontinence (Fig 5b). While the bladder base descends as a whole in the erect as compared to the recumbent position it is specifically the region of the internal sphincter which descends most and becomes the most dependent portion of the bladder. The bladder base assumes the 'pointed' appearance characteristic of the bladder poised for micturition. It then takes only very little further descent to open the internal sphincter and to allow a jet of urine to escape. This then is an altogether different base line than

the one which is seen in the continent nullipara or multipara and it is obviously brought about not by a general inadequacy of the bladder support but by a very particular one. In exertional incontinence it is precisely the region of the internal sphincter which is not supported and which permits this sphincter to become dependent so as to give the bladder base its characteristic appearance when the patient stands up. It is for this reason that most women with stress incontinence do not lose their urine when recumbent but lose it when they suddenly increase the intra abdominal pressure while they are up and about.

It has been common experience that women with severe incontinence are apt to lose their entire bladder contents with the initial stress. The fluoroscope reveals why this is so. The supports of the internal sphincter in these

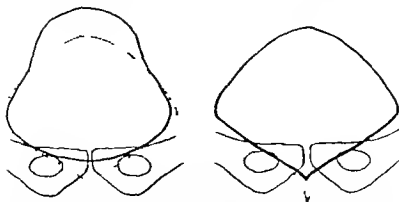


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Fig. 7. a, left I G, primipara, 11 days postpartum, stress incontinence unaffected by birth of child. Recumbent note smooth bladder base above symphysis. The internal sphincter is normally shut off. b, Erect not straining, not "pointing" of bladder base and "funneling" of internal sphincter revealing its congenital weakness.

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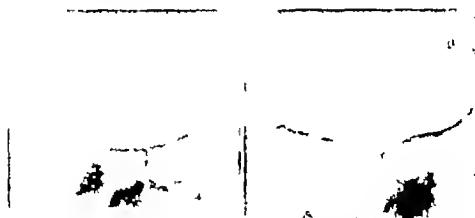


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women do not have enough tonicity to pull the bladder base up all the way and to level it off in order to inhibit the urinary stream and since these women fail to lift the bladder base up sufficiently high micturition goes on to completion once it has ensued.

Vertical incontinence in nulliparous women has always been puzzling. Two such cases were studied fluoroscopically and the particular cause of stress incontinence in these women also could be demonstrated. In both women the internal sphincter was perfectly normal when they were lying down (Figs. 6 and 7). When they were made to stand up the bladder base was still well supported but the internal sphincter now formed a deep dimple demonstrating a congenital weakness of the internal sphincter and its supports. When these women were asked to cough the downward pull on the funneled sphincter permitted a jet of urine to escape.

These cases once more demonstrate the fact that a perfectly well supported bladder base does not guarantee urinary continence in the erect posture if the support of the internal sphincter is incompetent.

It is well known that women may develop stress incontinence for the first time after a hysterectomy or after a cystocele repair. This embarrassing situation has been difficult to explain. One such case came to study.

Mrs. F. H. BILLY, 3005 N. 53rd St., Milwaukee, Wis., had a hysterectomy in 1910. Following this operation she developed severe stress incontinence. The physical and pelvic examinations were not remarkable. The fluoroscopic study of her bladder (Fig. 9) revealed the typical lesion of stress incontinence.

Just how a hysterectomy in some cases will interfere with the support of the internal sphincter is not clear at present. Further investigation of this problem is planned.

## SUMMARY

The mechanism of urinary control in the normal female consists of two parts: the internal sphincter and the pubococcygeus portion of the levator ani. The latter is particularly important for urinary control in the erect posture.

Vertical incontinence results from failure of the pubococcygeus to support the bladder neck.

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# ANTERIOR POLIOMYELITIS, EARLY AND LATE ELECTRICAL STIMULATION OF THE MUSCLES

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SACHS in 1910 wrote that the aim of therapy for the patient with anterior poliomyelitis should be to exercise muscles which cannot be exercised voluntarily. For this he recommended the use of a form of electrical current which would yield the best contraction with a current of moderate strength. Williams and Levick concurred and maintained that the treatment should be applied early after the diagnosis of the disease.

From 1939 to 1946 a series of articles appeared (5, 14, 16-21, 25, 28) which present evidence clearly establishing that the appropriate electrical stimulation of denervated muscle in laboratory animals retards the loss of weight and strength. However few observations have been made on man. Doupe, Barnes and Kerr obtained no effect in man when the rate of recovery of muscles after suture of the radial nerve was followed with and without galvanism. In the light of present knowledge the treatment used was inadequate and the criterion used was inappropriate. Shirley Jackson in 1945 in tensively treated patients with ulnar paralysis and obtained favorable results. Lau and Lewey reported that they obtained results similar to those of Jackson though in their cases the muscle atrophy was far advanced (6 to 20 months) when treatment was started and they treated their patients for only a relatively short period.

In 1940 an investigation was started to ascertain the therapeutic value of electrical stimulation of denervated muscle. It was felt that no previous investigator except Fischer

had used an optimal stimulus on the basis of what was known regarding the electrical excitability of muscle. In the first phase of this investigation a systematic search was made to find the wave form, frequency and intensity of the current most suitable for stimulating and retarding atrophy of denervated skeletal muscle. The second phase involved a controlled study on animals to ascertain the various factors other than the nature of the current which might retard the rate of loss of weight and strength of denervated muscle. The present article represents the application of our observations on animals to patients with anterior poliomyelitis. The results on patients with a muscle denervated by section of a nerve will be reported later.

## METHODS

*Late group* Because patients were not available in the early stage of the disease when the experiment was started it was necessary to select patients who had had anterior poliomyelitis for some time. However this was an advantage because it enabled us to work out the technique to be used in stimulating the paralyzed or paretic muscles. It was important to have our technique mastered before undertaking treatment in the early stage. Thirteen late patients were selected for treatment. These patients had had the disease for periods ranging from 6 months to 6 years.

*Early group* Later when the epidemic of 1946 occurred in Chicago it was possible to select 7 patients as soon as they entered the Chicago Municipal Contagious Hospital and the diagnosis of anterior poliomyelitis was made. The same number of patients were selected as a control group. The selection of both groups was made on the basis of the muscles involved and the apparent extent of the paralysis. At this stage of the disease it is obvious that such a selection is very artificial.

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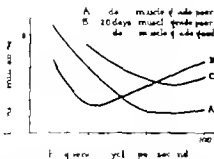


Fig. 1 Intensity-frequency curves of right hamstrings, patient 7 showing the change in the shape of the curve from the 8th to the 47th day after onset, during which considerable recovery had occurred. The initial and final curves are essentially normal.

ficial and open to much criticism. When 2 patients had the same muscle or group of muscles involved the patients whose muscles showed the lower grade in the muscle strength test was selected for treatment while the favored muscles of the other patient were selected as a control.

**Testing procedures.** As soon as the diagnosis of anterior poliomyelitis was made and prior to treatment the paralyzed or paretic muscles were given a manual strength test. The method used was that advocated by the National Foundation for Infantile Paralysis. The same physiotherapist always made successive examinations on the same patient.

In addition the muscles were tested for the reaction of degeneration. This test proved unsatisfactory, especially for children. The tests were difficult to duplicate even though made by the same examiner.

Electromyograms were recorded with a two-channel type A Offner electroencephalograph equipped with ink writer. The patient was enclosed in a shielded room during the entire examination. The electrodes were of copper measuring 2.5 centimeters by 5 centimeters. They were coated with Cambridge electrode jelly and two of them were securely attached by means of Scotch tape to the skin over each muscle being examined. In each instance the affected muscle, its antagonist and the identical contralateral pair were examined. The examination was made as follows: (1) an active movement of one muscle recording from the active muscle and its antagonist; (2) repeating (1) but recording from the contra-

lateral pair; (3) active movement of antagonist and recording from active muscle and antagonist; (4) repeating (3) but with recording from identical pair; (5) this entire procedure was then repeated with the contralateral pair. A similar procedure but with passive motion was carried out. The range and duration of the passive movement was kept constant as possible for each muscle. In some instances the active movement was carried out against resistance.

Intensity frequency curves of the muscles selected for treatment were taken. A sine wave current was used in this test because the muscle response would always occur at the same point (peak) of the cycle. Frequency was plotted against current intensity (Fig. 1). The current intensity sufficient to produce a threshold contraction was recorded. This curve enabled us to select the frequency to be used for treatment.

Circumferential measurements were taken from a constant distance from a set anatomical landmark. Contralateral parts were used as a control for the late group.

All the tests were repeated every 3 months until discharge. In addition a subjective evaluation of the patient's progress was made.

**Treatment.** Once a patient was selected for electrical muscle stimulation the muscles were stimulated daily for 6 days a week. The generator used was a Variable Frequency Wave Generator built to yield a current form and range of frequencies which have been found (36) to be essential. With this generator it is possible to develop the maximum tension in the muscle with the minimum current intensity. The current delivered by it is sinusoidal in form (Fig. 2a). The frequency of the current can be varied from two to six thousand cycles per minute. It is possible to change gradually from one frequency to another while the patient is in the circuit. With frequencies from thirty to six thousand cycles per minute we find it more convenient to convert cycles per minute to cycles per second. Thus it is less cumbersome to speak of one-half to one hundred cycles per second. When the current reaches a frequency of two to one hundred cycles per second the current may be modulated or surged 100 per cent sinusoidally to

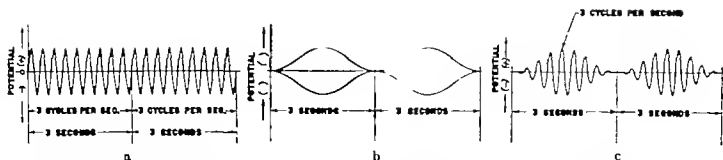


Fig. 2. a, Fundamental sinusoidal current 3 cycles per second. b, Modulating envelope of 3 seconds duration or

20 modulations per minute. c, Modulated sinusoidal current with carrier frequency of 3 per second

prevent a continuous tetanic contraction of the paretic muscle without relaxation (Fig. 2b). Modulation of the fundamental sine curve (Fig. 2c) prevents this and gives a graduated contraction similar to normal activity. The number of modulations per minute (Fig. 2b) determines the contraction rate of the muscles stimulated. This current we have termed a modulated sinusoidal current with a carrier frequency of two to one hundred cycles per second (Fig. 2c).

The frequency to be used for treatment was selected from the intensity frequency curve similar to that illustrated in Figure 1. The frequency requiring the lowest current intensity for a threshold contraction was selected. This initial frequency was used until later examinations showed the muscle responded maximally to a different frequency. When the frequency was two or more cycles per second this fundamental wave was modulated as previously explained. The modulation rate (the rate at which the muscles contracted and relaxed) was maintained consistently at a rate of twenty four times per minute throughout the entire course of treatment.

The complete technique of applying the electrodes to the muscles under stimulation will be dealt with in another communication. In some instances the unipolar technique was used while in others it was necessary to use a bipolar application. Patients differed a great deal and one could never predict with precision just where the point of maximum muscle irritability would be found. When possible the muscle was made to contract against resistance either by working against a weight or tying a foot for instance to the leg of the treatment table. Vigorous muscle contractions were secured. Each muscle or group of

muscles was stimulated daily. The muscles were stimulated for 10 minutes unless fatigue occurred. Contrary to clinical teaching there is no danger of stimulating to or beyond fatigue but it has been shown (20, 21) that it is a waste of time because unless tension is developed in the muscle treatment is useless. Stimulating a muscle four times with appropriate rest periods between stimulations has been found (21) to produce maximum results. However we stimulated the muscles only once daily.

The lower extremities of our patients appeared to have subnormal temperature therefore we found that a preliminary application of heat was desirable. We used a heat cradle of incandescent light bulbs for this purpose.

Since this study was concerned with human patients physiotherapy other than electrical stimulation was used. In the late group the physiotherapy they had received previously was continued. In the early group treatment consisting of heat, passive stretching and muscle re-education exercise was given three times weekly. Crutch walking was instituted as early as possible.

#### RESULTS IN THE LATE GROUP

The 13 patients in the group ranged in age from 2 years to 35 years. Four were females. The electrical stimulation was started from 6 months to 6 years after the acute onset of the disease. For example 1 patient 6 years after 2 at 2 years, 1 at 1 year, 1 at 9 months, 2 at 7 months and 4 at 6 months. The usual muscles were involved and need not be listed here.

In these 13 patients a total of 48 muscles were treated for from 4 to 18 months the average being 9 months and a total of 36 muscles were not treated.

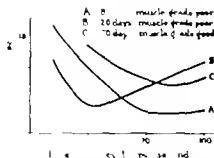


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ing a large number with zero strength for treatment and selecting a large number with fair strength for no treatment. This was inadvisable from a statistical viewpoint which teaches that the controls and treated muscles should have been equally distributed between the various grades of strength. Though greater improvement occurred in the muscles electrically stimulated the difference and improvement is not statistically significant. Nevertheless the increase in strength is in the same direction as the increase in girth. When the increase in strength is correlated with the increase in girth a good degree of correlation is obtained (the correlation coefficient was  $r = +0.69$ ).

**General observations.** Twelve of the thirteen patients manifested objective improvement relative to girth strength or both during the period of treatment of one or more of their paralyzed muscles as compared to nonstimulated muscles. Improvement however also occurred in nonstimulated muscles.

Four of the 13 patients whose muscles had been paralyzed for 7, 9, 10 and 25 months showed no improvement in voluntary motor function during the 12 to 18 months of observation according to the subjective judgment we formed by visually studying them. One patient showed neither objective nor subjective improvement after 5 months of treatment and was referred for operation to stabilize the ankle to counteract foot drop. The remaining 8 did manifest improvement in voluntary motor function and their stimulated muscles had been paralyzed in 3 for 6 months in 1 for 7 months in 1 for 11 months in 2 for 12 months in 1 for 21 months and in 1 for 6 years.

The following protocols indicate the type of subjective improvement observed by us.

**Patient 2.** Male 31 years of age electrical stimulation started 2 years after onset. At the initial examination the left knee joint was unstable and tired easily. After 5 months of treatment the knee joint was more stable and less easily fatigued.

**Patient 4.** Male 4 years of age electrical stimulation started 7 months after onset. At initial examination the left arm could not be abducted to side or front and elbow flexion was weak. After 1 year of treatment the arm was abducted side and front 10 times each, raised overhead 8 times without load and abducted 3 times with a 1 pound load. Forearm flexion definitely improved.

TABLE I—STRENGTH CHANGES IN 36 UNTREATED AND 48 TREATED MUSCLES IN THE LATE GROUP AND 59 TREATED MUSCLES IN THE EARLY GROUP THE PATIENTS FOLLOWED FROM 12 TO 18 MONTHS

Grade	N. of muscles in initial grade	Grade at end of experiments						Total of improvement
		Zero	Trace	Poor	Fair	Good	Normal	
3	1							
4								
Total	36		6	1	3			5*

A 36 treated muscles, late group

			6					
	6		9	3				9
	4							
3	7					4		3
4								
Total	48		20	3	1	6		24†

C 59 treated muscles, early group

	3	9	0					0
	25	4		4	4	3		1
	9				6			3
3	4							4
4								
Total	50	4		1		7		10‡

$\frac{1}{36} = 2.7\%$  improvement as group  
 $\frac{1}{48} = 2.1\%$  improvement as group  
 $\frac{1}{59} = 66\%$  improvement as group

**Patient 6.** Female 3 years of age electrical stimulation started 12 months after onset. At initial examination the patient could not sit up, could not balance with crutches and braces, could not crawl without brace and wore two long leg braces and crutches. After 10 months of treatment patient sits up well with good posture, wears one leg brace and crutches is less easily fatigued but balance is unimproved and knocks knees.

**Patient 8.** Female 30 years of age electrical stimulation started 6 years after onset. At initial examination patient wore 2 long braces and crutches could walk 25 feet twice daily with marked fatigue. Balanced alone with braces for 1 to 2 seconds with 2 braces was able to get out of wheelchair alone. After 9 months of treatment patient uses 1 long leg brace and 2 crutches, walks 300 feet twice daily with same fatigue as for 25 feet previously. Balances

*The current used for stimulation or the range of electrical excitability of the muscles stimulated* Eighteen of the muscles responded maximally to an unmodulated sinusoidal current ranging in frequency from 15 to 60 cycles per minute. Thirty of the muscles responded maximally to a modulated sinusoidal current with a carrier frequency varying from 5 to 15 cycles per second. The largest number, 50 per cent, responded to a modulated sinusoidal current with a carrier frequency of 5 cycles per second. Another 35 per cent showed a maximal contraction when stimulated at a frequency of 1 per second or less. Since the optimal frequency to produce a maximal contraction in normally innervated human muscles ranges from 15 to 100 cycles per second, all but 4 of the muscles stimulated by us may be considered to be partially denervated. The more fibers denervated in a muscle the lower the frequency required to give a maximal contraction at minimal intensity.

Of the 48 muscles stimulated, 30 showed no change in the frequency required to yield a maximal contraction during the course of treatment. In 2 the frequency decreased showing some further degeneration, and in 16 the frequency increased indicating either a recovery in some of the motor neurones or a hypertrophy of the normally innervated muscle fibers.

*Measurement of girth* In 10 of the 13 patients it was possible to make reliable measurements of girth of either the leg, thigh or arm. The girth measurement constituted an attempt to quantitate what was detected with the eye in some cases or recorded with the camera. Whether the difference in the means between the initial and final average could be due to chance experimental error in making the measurements was determined by statistical methods.

Every final measurement made was greater than the initial measurement. The average of the initial measurement of 18 lower legs treated was 21.8 centimeters and the measurements at the end of the treatment was 23.2 centimeters. This difference of 1.4 centimeters is significant ( $t=5.38$ ). The average initial measurement on the 14 thighs treated was 30.8 centimeters and the final measurement

was 32.7 centimeters. The difference of 1.9 centimeters is significant ( $t=4.75$ ). The average initial measurement on the 13 arms measured was 19.2 centimeters and the final was 21.5 centimeters. The difference of 2.3 centimeters is significant ( $t=8.8$ ).

The increase in girth was not due to an increase in subcutaneous fat. Nevertheless because 6 of the 10 patients were in various stages of growth (2 to 16 years of age) the possibility that growth was responsible had to be considered. Of the 6 patients, it is notable that 5 of them showed a greater increase in the girth of the treated extremity. The increase varied from 0.32 to 1.91 centimeters; the first figure being almost negligible but consistently observed. These patients had been afflicted 1 at 6 months, 2 at 7 months, 1 at 10 months, and 1 at 12 months prior to the start of electrical stimulation. Improvement then was observed although they had had complete motor paralysis for 6 months or longer.

The other 4 patients, 19 years or over describe some special reference. *Patient 8*, a female aged 20, was afflicted in 1940, 6 years prior to reporting for this experimental study. This patient had received the best physiotherapeutic treatment available. Except for the right gastrocnemius which yielded a trace, the muscles of both legs were completely paralyzed as regards voluntary contraction. Under treatment the girth of both thighs and both legs increased (stimulation 8 to 10 months). *Patient 11*, a male aged 35, who was afflicted 21 months previously had the triceps of one arm treated for 13 months and the girth increased 3.49 centimeters. *Patient 13*, female aged 27, was treated for paralysis of both legs which had been present for 6 months. The girth increases ranged from 2.86 to 4.76 centimeters. *Patient 12*, a male aged 19, received treatment of the thigh and lower leg also 6 months after the onset of the disease; no increase in girth occurred but an improvement in strength was measured.

*Measurement of strength* The results obtained on the measurement of strength are shown in Table I. It is to be noted that 36 muscles were untreated and 48 were treated.

In selecting the muscles for treatment we decided to handicap the treatment by select

ing a large number with zero strength for treatment and selecting a large number with fair strength for no treatment. This was inadvisable from a statistical viewpoint which teaches that the controls and treated muscles should have been equally distributed between the various grades of strength. Though greater improvement occurred in the muscles electrically stimulated the difference and improvement is not statistically significant. Nevertheless the increase in strength is in the same direction as the increase in girth. When the increase in strength is correlated with the increase in girth a good degree of correlation is obtained (the correlation coefficient was  $r = +0.69$ ).

**General observations.** Twelve of the thirteen patients manifested objective improvement relative to girth strength or both during the period of treatment of one or more of their paralyzed muscles as compared to nonstimulated muscles. Improvement however also occurred in nonstimulated muscles.

Four of the 13 patients whose muscles had been paralyzed for 7, 9, 10 and 25 months showed no improvement in voluntary motor function during the 12 to 18 months of observation according to the subjective judgment we formed by visually studying them. One patient showed neither objective nor subjective improvement after 5 months of treatment and was referred for operation to stabilize the ankle to counteract foot drop. The remaining 8 did manifest improvement in voluntary motor function and their stimulated muscles had been paralyzed in 3 for 6 months in 1 for 7 months in 1 for 11 months in 2 for 12 months in 1 for 21 months and in 1 for 6 years.

The following protocols indicate the type of subjective improvement observed by us.

**Patient 2.** Male 31 years of age electrical stimulation started 2 years after onset. At the initial examination the left knee joint was unstable and tired easily. After 5 months of treatment the knee joint was more stable and less easily fatigued.

**Patient 4.** Male 4 years of age electrical stimulation started 7 months after onset. At initial examination the left arm could not be abducted to side or front and elbow flexion was weak. After 1 year of treatment the arm was abducted side and front 10 times each, raised overhead 8 times without load and abducted 3 times with a 1 pound load. Forearm flexion definitely improved.

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Grade	No. of muscles Initial grade	Grade at end of experiments						Total of improvement
		Zero	Trace	Poor	Fair	Good	Normal	

A 36 treated muscles, late group								
—	0	—	6	3	—	—	—	3
—	3	—	—	—	—	—	—	—
3	3	—	—	—	—	—	—	—
4	—	—	—	—	—	—	—	—
Total	36	—	6	3	3	—	—	9

B 48 treated muscles, late group								
—	—	—	0	—	—	—	—	—
—	6	—	0	3	—	—	—	9
—	4	—	—	—	—	—	—	—
3	7	—	—	—	—	4	—	3
4	—	—	—	—	—	—	—	—
Total	43	—	30	3	3	6	—	41

C 59 treated muscles, early group								
—	3	9	0	—	—	—	—	0
—	35	4	—	4	4	3	—	1
—	0	—	—	—	6	—	—	3
3	4	—	—	—	—	—	—	4
4	—	—	—	—	—	—	—	—
Total	59	4	—	3	—	7	—	10

5/36 = 41% improvement as group  
 1/43 = 57% improvement as group  
 30/59 = 66% improvement as group

**Patient 6.** Female 3 years of age electrical stimulation started 12 months after onset. At initial examination the patient could not sit up, could not balance with crutches and braces, could not crawl without brace and wore two long leg braces and crutches. After 10 months of treatment, patient sits up well with good posture, wears one leg brace and crutches is less easily fatigued but balance is unimproved and knocks knees.

**Patient 8.** Female 20 years of age electrical stimulation started 6 years after onset. At initial examination patient wore 2 long braces and crutches could walk 25 feet twice daily with marked fatigue balanced alone with braces for 1 to 2 seconds, with 2 braces was able to get out of wheelchair alone. After 9 months of treatment patient uses 1 long leg brace and 2 crutches, walks 300 feet twice daily with same fatigue as for 25 feet previously balances

*The current used for stimulation or the range of electrical excitability of the muscles stimulated* Eighteen of the muscles responded maximally to an unmodulated sinusoidal current ranging in frequency from 15 to 60 cycles per minute. Thirty of the muscles responded maximally to a modulated sinusoidal current with a carrier frequency varying from 5 to 15 cycles per second. The largest number 50 per cent responded to a modulated sinusoidal current with a carrier frequency of 5 cycles per second. Another 35 per cent showed a maximal contraction when stimulated at a frequency of 1 per second or less. Since the optimal frequency to produce a maximal contraction in normally innervated human muscles ranges from 15 to 100 cycles per second all but 4 of the muscles stimulated by us may be considered to be partially denervated. The more fibers denervated in a muscle the lower the frequency required to give a maximal contraction at minimal intensity.

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*Measurement of girth* In 10 of the 13 patients it was possible to make reliable measurements of girth of either the leg, thigh or arm. The girth measurement constituted an attempt to quantitate what was detected with the eye in some cases or recorded with the camera. Whether the difference in the means between the initial and final average could be due to chance experimental error in making the measurements, was determined by statistical methods.

Every final measurement made was greater than the initial measurement. The average of the initial measurement of 18 lower legs treated was 21.8 centimeters and the measurements at the end of the treatment was 23.2 centimeters. This difference of 1.4 centimeters is significant ( $t = 5.38$ ). The average initial measurement on the 14 thighs treated was 30.8 centimeters and the final measurement

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*Measurement of strength* The results obtained on the measurement of strength are shown in Table I. It is to be noted that 36 muscles were untreated and 48 were treated.

In selecting the muscles for treatment we decided to handicap the treatment by select

alone with braces for 30 minutes and with one brace can get in and out of wheelchair alone.

*Patient 10* Male, aged 2 years electrical stimulation was started 6 months after onset. At the initial examination one leg brace was worn activity was limited and child crawled and preferred to go without brace. One year later one leg brace was worn and activities of a normal three year old child were performed such as climbing and walking can not run and ride bicycle or scooter.

*Patient 11* Male 35 years of age, who had been afflicted 21 months prior to the application of electrical stimulation. On first examination he was using 2 drop foot braces and 2 crutches and was exhausted after walking 50 feet with apparatus and had to rest for one hour before he could repeat. He was able to balance and stand alone with support for 1 or 2 minutes but could not go up or down stairs with or without aid and bend and touch the floor and straighten up again. He could extend the forearm against gravity with great effort. After 10 months of treatment he could walk 125 feet with braces and crutch and could repeat every 5 minutes. He could ascend one flight of stairs by holding railing and bend over touch floor and straighten up. He was also able to extend forearm against a 1 pound weight five times. After 13 months he discarded the right ankle brace drives his car can sit on chair without support.

*Patient 12* Male aged 19 years electrical stimulation started 6 months after acute onset of disease. At the first examination he dragged right foot and was exhausted after walking 500 feet with crutches. He could ascend stairs with great effort but could not do a deep knee bend or bend to touch toes and return. He could not dance or play drums. After 11 months of treatment he walked any distance desired climbed stairs one at a time with ease, used streetcars dances and plays drums professionally drives a car and does not drag the right foot. Six months later he rode a bicycle and played a base drum with right foot for an entire evening.

*Patient 13* Female 27 years of age electrical stimulation started 6 months after acute onset of disease. At the initial examination the patient after taking five steps with two crutches developed tremors in both arms and was able to stand with two crutches for 10 to 20 minutes. She was unable to get into or out of wheelchair and to dress herself. After 9 months of treatment the patient could walk 50 feet on crutches and 200 feet in walker. She could dress herself and get into and out of wheelchair or bed unaided and use left leg working foot pedal of sewing machine.

All these 8 patients though the muscles stimulated had been completely paralyzed for 6 months to 6 years showed real functional improvement during the period of treatment the least improvement being shown in the case of patient 8

#### RESULTS IN THE EARLY GROUP

During the 1946 epidemic a group of 7 patients were selected for treatment during the acute course (first 10 days) of the disease on the basis of the severity and extensiveness of the paralysis as determined by strength tests, electromyography, and clinical experience. A 'control group' of less afflicted patients was selected for observation. Both groups received the usual physiotherapeutic treatments. Electrical stimulation was started from 10 to 34 days after the acute onset of the disease and continued from 11 to 14 months.

*Electrical excitability of muscles stimulated*  
The frequency required to yield a maximal contraction was followed. At the start of treatment of the 57 muscles stimulated 5 responded maximally to a frequency of 15 cycles per second 15 to a frequency of 10 cycles per second 22 to 5 cycles per second 1 to 3 cycles per second and 14 to 1 cycle per second. At the end of the treatment period 5 responded maximally to a frequency of 15 11 to 10 33 to 5 3 to 3 and 5 to 1 cycle per second.

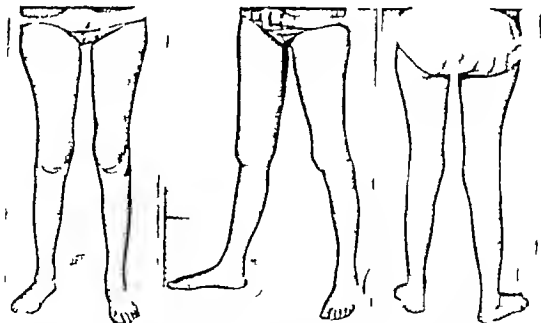
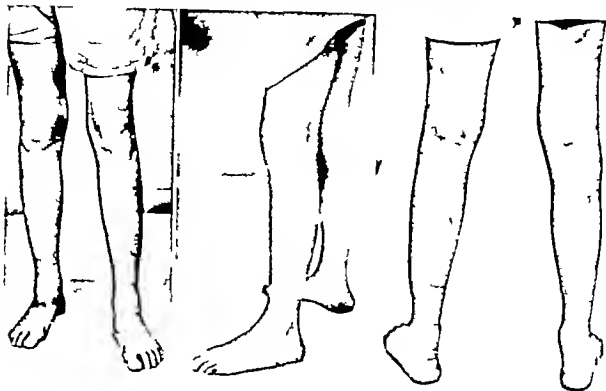
Judging from the changes in the frequency required to produce a maximal contraction 21 remained the same 21 improved and 15 became worse.

*Measurements of girth* Of the 7 patients only 2 showed any decrease in the girth of the paralyzed extremities 1 of these patients lost 31 pounds during the period of therapy and the other 8 pounds.

When the girth measurements of the lower leg are averaged the initial was 28.2 centimeters and the final 29.3 centimeters ( $t=2.68$ ) those of the thigh were initially 39.1 centimeters and finally 40.1 centimeters ( $t=1.33$ ) those for the upper extremity initially 24.9 centimeters and finally 25.8 centimeters ( $t=1.88$ ). Though these differences were not significant it is quite notable that the paralyzed extremities did not lose any girth but tended to gain. In view of the fact that in the one year of therapeutic observation there was no significant change in body weight except in the 2 cases mentioned it is clear that the stimulation or treatment very definitely prevented atrophy.

This prevention of atrophy is illustrated in the two photographs of flail legs shown in Figure 3.





b

Fig. 3. The amount of trophy 5 months after onset of the disease. a, Patient 8; b, patient 9. Both patients have flail lower extremities. Patient 8 showed no decrease in girth of thigh or leg during 4 months and lost 8 pounds of body weight.

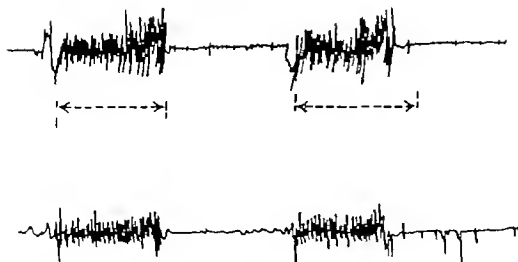
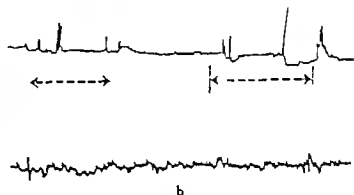


Fig 4. Course of "spasticity" in patient 11. Upper record—right anterior tibial muscle. Lower record—right gastrocnemius muscle. In both records passive stretching of the right anterior tibial muscle has been performed. The horizontal line between arrows indicates duration of stretch. Record A taken May 14, 1946. Record B taken November 14, 1947.



due to overwork or constant fibrillation (29, 30) and that muscles atrophy from disuse and since Bowden and Gutman (1) have found that few if any muscle fibers in man have undergone complete degeneration to fibrous tissue in 3 years it is reasonable to believe that appropriate electrical stimulation will cause such muscle to contract and may cause some hypertrophy. It has been shown that denervated muscle can be caused to contract in a normal manner by the appropriate electrical stimulus and that the earlier the application of treatment (10, 11) and with the application of some load (5, 6, 16-21, 25) the more the atrophy and loss of strength is retarded. There is no reason why these facts should not apply to those fibers in a muscle which are degenerating slowly as a result of the destruction of the anterior horn cell that supplies them as well as to those which are atrophying due to disuse or absence of voluntary use. The negative results reported in the literature were obtained with inappropriate currents; this also applies to the excellent in-

vestigation of Chor and his associates which was done specifically to ascertain the value of currents used by clinicians at the time that work was done. The negative results were due to a failure to apply the physiological principle of the intensity frequency curve to the selection of the most appropriate electrical stimulus for a maximal or effective contraction.

To retard atrophy the treatment must be adequate. This means that (a) vigorous contractions with tension must be secured (b) the proper wave form of current is important (c) the treatment must be given daily and each muscle stimulated two or three times (d) and the muscle should be stimulated to the point of fatigue. To stimulate a fatigued muscle with the proper current is not injurious to the muscle; it is simply a waste of time since the muscle does not develop tension. As already stated it is agreed that to prevent atrophy a vigorous contraction with tension is required. To obtain a vigorous contraction with tension in an anesthetized patient a current of low intensity must be used because the patient

*Measurement of strength* Fifty nine muscles were stimulated. Of these, 31 improved in strength, 22 remained the same and 6 became weaker (Table I)

As the strength tests were repeated it was quite evident at the second test that 10 to 14 days after the acute onset of the disease was too early to grade the full extent of the paralysis according to our observations, 1 month after the acute onset of the disease would be an approximate period for such appraisal

Since the muscles selected for treatment in the late and early groups were comparable in regard to the initial muscle grades of strength it is notable that the final grades are also comparable. This fact suggests that time is gained by starting treatment early

*General observations* All 7 patients regardless of the initial severity showed definite to marked improvement as would be expected. It is believed that the presentation of a protocol showing the improvement of each patient is unnecessary

#### THE RESULTS OF ELECTROMYOGRAMS AND RESPONSE TO STRETCH

Electromyograms were made on all the early patients and on all of the late patients who showed definite evidences of abnormality. Such evidences of abnormal innervation as prolonged stretch reflex spasticity and as activity on the heterolateral side on either active or passive movement were followed.

As has been reported by others, evidence of spasticity and abnormal reflex innervation was found in all the early cases. In our early cases it had disappeared or had markedly decreased at varying time intervals up to 7 months. In 1 of the patients who had not received electrical stimulation spasticity on stretch and heterolateral activity still persisted being increased over the early recordings, at 15 months.

Three of the patients in the late group showed a disturbance of reflex innervation. Patient 8 was particularly interesting because of the interval of 6 years between the acute attack of the disease and the start of electrical stimulation. In this case the prolonged stretch reflex or spasticity and heterolateral activity

disappeared during the period of treatment (10 months). Patient 11 who had been afflicted 21 months prior to the beginning of electrical stimulation manifested a very definite spasm in response to stretch as well as heterolateral activity. This had almost completely disappeared after 2 months (Fig. 4). In patient 12 whose right leg had been paralyzed for only 6 months the evidence of abnormal reflex innervation disappeared after 12 months of therapy.

These observations are not recorded with the idea that electrical stimulation was specifically responsible, but to indicate how long evidence of abnormal reflex innervation may persist.

#### DISCUSSION

The observations made during this investigation have proved several points but leave the most practical points open for further investigation.

When this work was first contemplated we were told that one could not cause the atrophied muscles of the late cases of anterior poliomyelitis to contract by means of electrical stimulation and particularly the paralyzed muscle of the early case without causing intolerable pain. We have definitely demonstrated this view to be false. Such a view was based on a failure to comprehend the full significance of the physiological principle of the intensity frequency curve in electrical stimulation.

Our results on the early cases show that atrophy of the muscles can be markedly retarded even prevented for one year by adequate daily electrical stimulation of the muscle of the completely paralyzed or so called flail limb. Our measurements of girth also show that some hypertrophy was obtained in the paralyzed muscles of the late cases. This was slight on the average but nevertheless was an increase that could have occurred by chance or error in measurement in less than 1 out of 100 cases. We had anticipated these results because of our work and that of others on lower animals and because of our unpublished observations on human patients with peripheral nerve paralysis. Since it is clear that the atrophy of denervated muscle is not

plugged by a small tag of the otherwise normal and freely movable omentum. This plugging was so efficient that there was no leakage of pancreatic juice even in the 1 dog in which the pancreatic duct was distended behind the plug. It was obvious that the plugging by omentum was a form of self healing and that spilling of pancreatic juice into the peritoneal cavity was impossible after the omentum had become densely adherent to the region of the transected duct.

In contrast to these observations were the results in the other experiments of this series. With 1 exception, the dogs that had been fed before operation showed striking intraperitoneal changes at autopsy. The open duct was usually covered by omentum but this cover had not succeeded in completely sealing off the pancreatic duct and a large amount of fat necrosis and edema was frequently found under this cover as well as outside of it.

The dogs which had been starved before operation but given food shortly afterward though most of them ate only part of the food likewise showed marked changes. However the fat necroses were mostly localized in the pancreatic region and were not so extensive as in the dogs fed before operation.

The fact that intra abdominal fat necrosis was almost exclusively confined to the dogs which had been fed shortly before or after the operation suggested that increased postoperative flow of pancreatic juice caused by the secretin liberating effect of preoperatively or postoperatively ingested food played a decisive role. The observation that the intra peritoneal changes were much more extensive in the dogs fed before operation than in the ones fed afterward seemed to find its explanation in the fact that postoperative feeding could not be started before 8 to 10 hours after the operation after the effects of anesthesia had worn off and that the dogs took only part of the food thereafter.

To ascertain whether or not vagal stimulation of the pancreas has similar effects experiments were performed in which the dogs were starved before and after operation but were given vagotonic medication postoperatively. The dogs were sacrificed after only a short interval because we were interested mainly in

the observation of the immediate intra abdominal reaction. All the dogs had fat necroses in the pancreatic region and under the tag of omentum that covered the area of the transected duct. This shows that vagal stimulation of pancreatic secretion also though to a lesser degree than stimulation by secretin interferes with the healing mechanism which is regularly found in starved animals.

Transsection of the main pancreatic duct without subsequent ligation was tolerated so well by the starved dogs and followed by so remarkably few intra abdominal changes that we continued our experiments by studying the consequences of more extensive cutting of the pancreas. In the second series of experiments pancreatic duct and glandular tissue were cut wide open with results very similar to those in the first series of dogs.

The dogs starved before and after operation with only 1 exception showed merely insignificant intra abdominal findings at autopsy in spite of the extensive injury to the pancreas. The healing mechanism was the same as in the other experiments only the omentum was adherent to a wider area, and the pancreas was more indurated.

Most of the animals that had been fed before operation showed extensive fat necrosis in the peritoneal cavity.

Though the postoperatively fed animals of this series took water freely—probably due to the more extensive surgical procedure—they refused food after the operation or vomited shortly after eating so that no feeding effect could be expected. Therefore, dextrose was added to the drinking water postoperatively and the dogs drank considerable amounts of it. Very extensive intraperitoneal changes were found in these dogs similar to those in the dogs fed before operation.

It was evident in both series of experiments that in starved animals the peritoneum was protected from inflow of pancreatic juice by a most efficient sealing of the open pancreatic ducts. This was generally effected by omentum though colon or duodenum were involved occasionally. However the smooth healing in the starved dogs cannot be explained by the plugging process alone. An arrest or at least a pronounced decrease of pancreatic secretion

fluid to 1 dog a moderate number of generalized fat necroses to another animal localized fat necroses in the region of the pancreas and between the pancreas and the omentum in all 5 animals and some fat necroses in the pancreas in 1 dog

### *Series 2 Pancreatic Duct Slit Open*

**Group 1** Eleven dogs started before and after operation. To 4 dogs, one branch of the main pancreatic duct was slit open and both branches in the remaining 7 dogs. Seven dogs were starved for 3 days after operation, 2 for 5 days, 1 for 7 days and 1 for 8 days. A few dogs appeared quite sick for the first few days but most of the animals showed remarkably little postoperative reaction. Two dogs died on the sixth day and 2 on the seventh day after the operation. Three of these dogs died of pneumonia and 1 of diffuse fat necrosis with a large amount of hemorrhagic intraperitoneal fluid. The other 6 animals were sacrificed between the eighth and twenty-fifth postoperative day. All dogs except the 1 just mentioned showed only very few intra-abdominal changes. Only 4 had a small amount of bloody or pinkish exudate. One showed a few scattered fat necroses and 2 others showed a few fat necroses in the region of the pancreas. The area of the incised duct was covered in 1 dog by colon, and in the others by omentum. The firmness of the adhesion of omentum was in proportion to the time interval between operation and autopsy. The area of the incised duct was filled with a small clot in one dog and was slightly hemorrhagic in another. In 2 dogs, some purulent material was found between the incised duct and the cover of omentum. In 4 dogs the pancreas appeared normal while it showed various degrees of induration in the remaining animals. There were no obvious differences between the findings in the dogs which had only one branch and those that had both branches of the main duct incised.

**Group 2** Eight dogs fed a few hours before operation but starved postoperatively for 2 to 8 days. One branch of the pancreatic duct was opened in the first 4 dogs, and both branches in the remaining 4. Some animals were very sick postoperatively and 3 died on the second, third and fourth days respectively. Another

very sick dog was sacrificed the second day after operation. The other 4 dogs seemed to be in good condition and were sacrificed 8 and 9 days after operation. In 2 dogs, the appearance of well being was in contrast to the autopsy findings, which revealed most extensive intra-abdominal changes. In summary the findings in the 8 dogs of this group were bloody or pinkish intraperitoneal fluid in 5, most extensive localized and generalized fat necrosis in 3, less extensive localized and generalized fat necrosis in 3, and no fat necrosis at all in 2 dogs. The area of the incised duct was covered by omentum in all but 1 of the dogs. In 2 there was suppuration under the cover of omentum. The omentum was firmly adherent only in the dogs without fat necrosis. The pancreas was partly hemorrhagic in 3 dogs, showed edema and fat necrosis in 1, and various degrees of induration in 3. Whether one or both branches of the pancreatic duct had been incised did not seem to affect the results.

**Group 3** Four dogs, starved preoperatively but given food and drinking water with dextrose shortly after operation. Both branches of the pancreatic duct were incised in the animals of this group. One dog died on the third, another on the fourth postoperative day. The other 2 dogs were sacrificed on the third and fifth postoperative day respectively. All animals seemed sick in the postoperative period. The autopsy findings were various amounts of intraperitoneal fluid in 3 dogs, extensive fat necrosis in 3, less extensive fat necrosis in the fourth. The area of the incised ducts was somewhat hemorrhagic in all 4 animals. It was covered by loosely attached omentum in 3 and by somewhat adherent omentum in the fourth. The pancreas was partly hemorrhagic in 1 dog but it appeared normal in the other 3.

### DISCUSSION

The experiments of series 1 demonstrated that transecting the main pancreatic duct and leaving it open did not kill the animals within a short time and, under certain conditions, was not followed by intraperitoneal pathologic changes. The dogs that had been starved before and after the operation showed a minimum of intra-abdominal changes at the autopsy. The cut duct, with 1 exception, was

# THE EXPECTANT TREATMENT OF PLACENTA PREVIA

## A Study of 50 Maternal Deaths

CHARLES A GORDON M.D. F.A.C.S., and ALEXANDER H ROSENTHAL, M.D., F.A.C.S.  
Brooklyn, New York

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In Brooklyn where 1011 maternal deaths occurred in the ten year period 1937 to 1947 145 were assigned officially to hemorrhage. Upon study of case reports of all maternal deaths however hemorrhage was found to be the chief cause of death in 290 cases. Placenta previa was associated with death in 50 cases.

Placenta previa is still a major complication of pregnancy though wider use of cesarean section and blood transfusion particularly in the last decade has considerably reduced its mortality. Recent definite trend toward complete abandonment of dilating bags and version with stricter limitation of operative procedures to cesarean section and simple rupture of the membranes should result in minimal mortality in communities where obstetrical resources are adequate.

It has long been believed and taught that there is no place for expectancy in the management of placenta previa and that treatment should be initiated just as soon as the diagnosis has been made. The considerable fetal mortality has long been accepted as a natural corollary of early intervention. If there is little to support general belief that initial hemorrhage even though it may not be serious will be followed by others any one of which may be fatal expectant treatment should bring about substantial reduction in fetal mortality.

In 1945 Macafee (4) and Johnson independently yet almost at the same time stated that initial hemorrhage is rarely or never catastrophic, apart from vaginal manipulation and that recurrent hemorrhages do not lead to

fatal hemorrhage. They feel certain that expectant treatment is safe and proper provided certain precautions are taken. Macafee has reported 191 cases with but 1 maternal death (0.5 per cent) and a total infant mortality of 42 (22 per cent). Johnson reported 79 cases with 1 maternal death and a fetal mortality of 22.2 per cent. It is of interest to find that Davis has reported from the Chicago Lying In Hospital where expectant treatment has not been practiced 325 cases with but 2 maternal deaths (0.6 per cent) and a fetal mortality of 31.6 per cent. On the basis of these figures alone it would appear that the chief argument for expectant treatment is lowered fetal mortality.

Macafee (4) is willing to allow primigravidae but not multiparas to remain at home provided they live reasonably near the hospital and are warned not to permit any vaginal examination before admission. He knows of no case in which a severe spontaneous hemorrhage occurred in a primigravida. Numerous small hemorrhages cause him no anxiety. Curiously enough in only one of his cases was blood transfusion necessary.

Johnson will permit a patient with placenta previa to remain at home if hospitalization is impracticable for economic reasons having her return to the hospital for blood study after bleeding episodes of any consequence. He would be surprised to learn of a maternal death from placenta previa where nature has been allowed to take its course as regards labor and delivery. In fact he offers a reward for such a case. He states that the placenta should be allowed to separate naturally and that this is especially true if free bleeding is present.

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must have occurred simultaneously with the plugging because otherwise marked intraductal accumulation of pancreatic secretions would have resulted, with subsequent distention of the duct system however dilatation of the pancreatic ducts was found in only 1 dog.

Stimulation of the pancreas by liberation of secretin due to preoperative or postoperative feedings and similarly by vagal stimulation obviously counteracts the arrest of pancreatic secretion which occurred in the starved animals. Consequently when the intraductal secretory pressure of the pancreas exceeds the adhesive power of the omental plug leakage of pancreatic juice takes place and causes intraperitoneal fat necrosis. However after a certain time the gland no longer seems to respond to normal alimentary stimuli. This is similar to the findings in dogs with ligated pancreatic ducts and is confirmed by the results of serum amylase tests which showed an initial postoperative rise with return to normal after a few days, just as is the case after ligation of the duct. Autopsy revealed induration of the pancreas in a number of dogs of both series. This is the consequence of the sealing off of the pancreatic duct and as is known from experimental ligation is the forerunner of more or less complete atrophy of the glandular tissue, which eventually must take place if the pancreatic duct is occluded.

#### SUMMARY AND CONCLUSIONS

Transsecting the pancreatic duct or slitting it wide open as a rule does not cause intraperitoneal fat necrosis if the animal has been starved before and after operation. Following the operation omentum attaches itself to the wound of the pancreas and plugs the open duct. At the same time an arrest of pancreatic secretion seems to occur. After a few days the omental plug is firmly adherent to the pancreas and the healing process is terminated as far as the prevention of leakage of pancreatic juice is concerned. However the sealing off of the pancreatic duct, similar to closure of the duct by ligature eventually is bound to lead to fibrosis and atrophy of the glandular tissue.

Preoperative or postoperative feeding of the animals is usually followed by extensive intra-

abdominal fat necrosis while postoperative vagotonic medication leads to similar but less extensive changes. Obviously feeding is a more potent stimulus for pancreatic secretion than a few injections of pilocarpine or prostigmine. It is concluded that increased flow of pancreatic secretions due to secretin as well as to vagal stimulation offsets the protective plugging process. This allows pancreatic juice to enter the peritoneal cavity and to cause fat necrosis.

From these animal experiments conclusions can be drawn which may be of importance in the treatment of surgical or accidental wounds of the pancreas and in surgery of the pancreas in general. The following measures are suggested for clinical trial.

1. If a pancreatic duct is transected and if implantation into the intestinal tract is not feasible it may be best to attach omentum to the ligated stump since omentum seems to be capable of sealing off the duct even if the ligature should fail.

2. In the case of injuries to the glandular tissue of the pancreas, it may be advisable to attach omentum to the pancreas even if the lesion of the pancreas has been sutured. This may help to reduce the incidence of postoperative pancreatic fistulas.

3. In cases of elective surgery on the pancreas, or when the gland may be injured in the surgical procedure it seems advisable to prolong the routine period of preoperative starvation and to give preoperative medication which does not stimulate pancreatic secretion but which depresses it.

4. After operation on and injuries to the pancreas it seems advisable to keep the external pancreatic secretion at a minimum for several days by inhibiting it through medication and by avoiding humoral as well as vagal stimulation of the pancreas.

Although these statements are based on controlled animal experiments, clinical observations will have to show to what extent they are applicable to clinical surgery.

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TABLE I.—CAUSES OF DEATH

	Pelvic delivery	Cesarean section	Undelivered	Total
Infection		14		14
Hemorrhage			1	1
Rupture of uterus	6		1	7
Cardiac failure				
Transfusion hemolysis				
Pulmonary embolism				
Postoperative shock				
Eclampsia				
Spinal anesthesia				
Total	6	14	2	22

ness to hemorrhage. With this we agree yet their importance warrants careful consideration. The expectant treatment advocated by both authors is based upon their experience and belief that hemorrhage, whether initial bleeding or subsequent and no matter how often repeated will not cause death in the absence of vaginal examination or manipulation.

Since we believe that the risk of this method of treatment may best be measured by careful review of the sequence of events which have preceded death in a considerable number of cases, we have studied 50 case reports of maternal deaths associated with placenta previa.

#### MATERIAL FOR STUDY

All 50 deaths occurred in Brooklyn in hospitals of various types. There were 10 primigravidas and 39 multigravidas. In 1 case parity is unknown. 58 were white women and 2 were negroes. The duration of pregnancy was 6 to 8 months in 13 cases, 8 months to term in 14 cases and 21 women were at term in 2 cases the duration of pregnancy was not stated.

Cesarean section had been performed in 22 cases. Delivery from below had occurred in 25 cases. 3 women died undelivered. In 5 cases the first hemorrhage occurred after the onset of labor. The causes of death appear in Table I.

Placenta previa was complete in 25 cases, partial in 9 cases and marginal in 12 cases, not stated in 4 cases.

Hemorrhage followed several patterns with considerable variation in the time of onset

TABLE II.—CONDITION OF PATIENT BEFORE ACTIVE TREATMENT

Type	Good	Fair	Poor
1. Marginal	4	6	
2. Partial			3
3. Complete	6	10	1
Unknown		3	
Total		19	4

Nephrosclerosis, case  
Eclampsia, case

amount of initial hemorrhage, and the time and character of recurrent bleedings. It may be summarized as follows:

- 1 Initial profuse antepartum hemorrhage, 12 cases.
- 2 Spotting for 4 or 5 weeks followed by moderate or profuse hemorrhage, 3 cases.
- 3 Recurrent slight bleedings for 1 to 4 weeks followed by moderate or profuse hemorrhage, 15 cases.
- 4 Recurrent slight bleedings for 4 weeks to 4 months followed by moderate or profuse hemorrhage, 7 cases.
- 5 Initial moderate bleeding followed within 1 to 6 weeks by a second moderate or profuse hemorrhage, 7 cases.
- 6 One episode of bleeding in the 7th month, 1 case.
- 7 First hemorrhage intrapartum, 5 cases.

It is not practicable to discuss the general condition of each patient before treatment was instituted or to describe hemorrhage in terms other than slight, moderate, profuse and severe as in the case reports of death. As a result of hemorrhage, however, 13 women were in poor condition before active treatment, 7 were in shock, 5 actually in labor (Table II). In primigravidas antepartum hemorrhage was not severe in any case except after rectal examination (2 cases). In 1 case in which severe hemorrhage occurred early in labor, brief clinical data are of interest.

**CASE 1.** In a patient of 35 years, severe hemorrhage occurred a few hours after the onset of labor in the 38th week of pregnancy. She was admitted to the hospital in shock, with a pulse rate of 140. Plasma and 500 cubic centimeters of glucose solution were administered and cesarean section was performed. Hemorrhage continued postpartum, and the uterus and vagina were packed. Death occurred 3 hours later.

In multiparas hemorrhage was more severe. Of the 7 women admitted to the hospital in shock, 6 were multiparas, 4 were in labor. The significant clinical data of the only 2 cases in which severe antepartum hemorrhage occurred follow:

**CASE 2.** A secundigravida aged 34 years at term was admitted to the hospital with pain in the chest, dyspnea and cyanosis. There was no vaginal bleeding yet she had bled in the 34th week. Rectal examination was followed by profuse hemorrhage. Death 1 hour later with baby undelivered was attributed to pulmonary embolism. At autopsy the lung condition was not significant. Complete placenta previa was present.

**CASE 3.** A secundigravida aged 29 years suffered severe initial hemorrhage 2 hours before the onset of labor in the 38th week of pregnancy. It was estimated that 2000 cubic centimeters of blood were lost in 4 hours before patient was admitted to the hospital in shock, with blood pressure 70/50 and pulse rate 150. Plasma (500 c.c.) and blood (500 c.c.) were administered. Six hours later after loss of fetal heart sounds, patient was examined vaginally and complete placenta previa was felt through a cervix which was dilated 4 centimeters. The cervix was then dilated manually and a No. 4 Voorhees bag was introduced. The patient complained of intense abdominal pain the uterus became boardlike and shock deepened. The bag was then removed and blood (500 c.c.) and plasma (500 c.c.) were again administered. The cervix was then dilated again manually and version and extraction of a stillborn fetus were performed through the placenta which was then removed manually. Death on the 9th day postpartum was due to embolism proved by autopsy.

#### MANAGEMENT

In no case was there record of a pelvic examination prior to hospitalization. In 4 cases rectal examination precipitated profuse hemorrhage and in several other cases repeated rectal examination did not. Not infrequently a patient was discharged from the hospital after vaginal examination failed to reveal placenta previa only to return later after another hemorrhage at home upon re-examination the diagnosis was clear. In most cases blood was transfused at some time before death yet the amounts were usually inadequate or transfusion was performed too late. The initial management is summarized in Table III.

In every case but 1 (eclampsia) hemorrhage contributed to death yet infection was the immediate cause of death in 19 cases, 15 of them after abdominal delivery.

TABLE III—INITIAL MANAGEMENT

Procedure	No. of cases
Cesarean section	22
Internal version	4
Version and extraction	8
Braxton-Hicks version	4
Rupture of membranes	3
Bag alone	3
Pinard maneuver	1
Vaginal pack	1
Incision of cervix and forceps	1
Undelivered, spinal anesthesia	1
Undelivered eclampsia	1
Undelivered, no treatment	1
Total	50

Postpartum hemorrhage and shock caused death in 23 cases, 3 after cesarean section and 20 following delivery from below. Extraction followed version in 8 cases, in 1 case after Braxton Hicks version. A Voorhees bag preceded version in 6 of these cases. In a patient with a marginal placenta previa the breech was extracted through a cervix dilated but 3 centimeters. In another case delivery was effected by forceps after lateral incisions in a cervix dilated less than 3 centimeters. And a patient treated by vaginal tamponade died of postpartum hemorrhage after precipitate delivery of twins. In another case rupture of the uterus followed the Pinard maneuver.

Severe postpartum hemorrhage occurred in all of these cases. Rupture of the uterus is known to have occurred in 2 cases while in another a deep cervical laceration was reported. In 5 additional cases all after version, though a tear in the uterine wall was not actually palpated. It is our belief that clinical evidence will support the diagnosis of ruptured uterus. With the exception of a death from severe infection 34 hours after version and extraction all 23 patients died within a few hours of delivery.

Fetal survival in the cesarean section group was 14 and in the pelvic delivery group 4.

#### DISCUSSION

In the management of placenta previa the prime indication is prevention of death from hemorrhage. Infection may not be controlled as well as hemorrhage proper management of hemorrhage is a clear prerequisite of treatment. Death from infection occurs more commonly after cesarean section, yet many women

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FEBRUARY 1949

## ONE-STAGE RESECTION AND ANASTOMOSIS OF THE COLON

A REVIEW of surgical literature of the past 5 years discloses a decided trend toward a return to primary resection and anastomosis of the colon. McKittrick in a recent (1948) comprehensive consideration of surgery of the colon wrote that "It shares with all other surgical procedures the improvement in results following the many advances in the care of patients that have occurred in recent years, tending I believe more nearly to standardize surgical treatment of cancer of the colon than has been possible before." The writer as a result of a survey by questionnaire undertaken in 1947 to determine current trends in the surgical treatment of carcinoma of the large intestine as practiced on surgeons with relatively large and proved experience in this field has reached the same conclusion. Thirty-six or 72 per cent indicated that in at least 50 per cent of cases they elected primary resection and

anastomosis as the procedure of choice. One stated that he never employs this maneuver while four claimed one hundred per cent performance. Between these extremes the varied incidence of performance was as follows: 5 to 24 per cent of cases, 7 surgeons; or 14 per cent, 25 to 74 per cent, 11 surgeons; or 22 per cent and 75 to 100 per cent of cases, 31 surgeons, or 62 per cent. Notwithstanding this popular preference for a one-stage operation it appears significant that 6 of the 10 surgeons in our survey who are generally conceded to be pre-eminent in this field and whose replies were tabulated separately estimated that they performed primary resection and anastomosis in not more than 25 per cent of instances. One of these T. E. Jones, has not anastomosed the distal colon primarily since January 1938. During a period when most of the surgeons in the majority group who now favor primary anastomosis performed exteriorization procedures exclusively, he was one of the principal advocates of immediate anastomosis which he accomplished with the relatively low mortality (for that period) of 14 per cent in 128 cases. Dissatisfied, however, with this rate he adopted the exteriorization technique of Rankin (obstructive resection) and in a series of 117 cases performed without the benefit of chemotherapy reported a mortality of only 5 per cent. Moreover the over-all hospitalization period averaged only 26 days, including the period for closure of the temporary colostomy. David employs an exteriorization operation in all but 5 to 10 per cent of cases and the Lahey Clinic in all but 10 to 15 per cent of such lesions. Rankin, Cole MacFee and Dixon perform primary

anastomosis in not more than 35 per cent of instances

Although a considerable majority of those interested in surgery of the large intestine are in agreement as to the operation of choice in lesions of the distal colon a decided difference of opinion prevails as to which factor or factors chiefly are responsible for the current relatively low mortality which accompanies resection and immediate anastomosis. A few notably Dixon Heyd and White believe that routine establishment of complementary proximal drainage favorably influences mortality whereas a majority (85 per cent) in the survey conducted by the writer especially Stone Waugh Meyers Wangenstein and Campbell have taken positive stands to the effect that such decompression as a routine measure is not essential to a low mortality in primary anastomosis. The Miller Abbott tube was considered a valuable adjunct to resection of the distal colon by only five whereas special mention was ascribed to the Devine colostomy by only three.

Controversy also continues concerning the comparative efficacy of the closed and open methods of intestinal anastomosis. Whipple Meyers and a few others have strenuously criticized the aseptic technique particularly those which employ a special clamp. On the other hand Stone Rankin Wangenstein Waugh White Pemberton Dixon, and McKittrick are among the majority (60 per cent in our survey) who believe mortality is favorably influenced by the closed technique. A similar division of opinion is found in the evaluation of chemotherapy and the antibiotics. Jones Stone Lahey Cattell Collier Wangenstein Gurd McKittrick and a few others use them not at all or only rarely. However most surgeons (84 per cent in our survey) consider these agents important ad-

juvants in primary anastomosis of the colon and utilize them routinely. The extremes are represented on the one hand by Jones who never employs chemotherapy in any form and on the other by Pemberton who feels that the part played by chemotherapy in the reduction of mortality in surgery of the colon is 'as spectacular and revolutionary as the changes wrought by iodine therapy in surgery of exophthalmic goiter. Actually there have not been reported sufficiently large series of cases to permit accurate evaluation of the favorable influences of any one therapeutic agent or technical maneuver. More likely, as recently emphasized by Allen, Ravdin, McKittrick and others a combination of factors have contributed to the improved results as (1) a better understanding and utilization of preoperative preparation especially as regards anemia and serum protein deficiency, (2) improvement in anesthetic methods and (3) the advent of chemotherapeutic agents for oral use during the preoperative period.

It is also difficult properly to determine the relative merits of obstructive resection and primary resection and anastomosis in the treatment of cancer of the colon prior to the publication of large series of cases in which are included such revealing data as operability, mortality and five year survivals. The fallacy of attaching significance to statistical consideration of a limited number of cases such as have been recently reported has been demonstrated frequently. Initial series of cases usually consist of carefully selected patients and as a consequence mortality is lowest for the first score or so of operations.

MacFee long an advocate of primary anastomosis as the procedure of choice recently aptly expressed the concern with which a number of us have viewed the all-or-none

attitude adopted by many surgeons in regard to primary suture of the distal colon after resection. He says "When primary resection is intended and an unforeseen complication is encountered there is always the inclination to proceed with the definitive operation as planned bearing in mind but at the same time disregarding the fact that conditions for the operation are not ideal. The results may be chastening to the surgeon and irreparably bad for the patients. It is the middle ground cases that offer the greatest temptation and therefore the greatest danger."

A. STEPHENS GRAHAM.

## PANCREATIC PHYSIOLOGY IN THE LIGHT OF RECENT SURGICAL EXPERIENCES

THE surgery of pancreatic neoplasms as developed in recent years has afforded considerable opportunity for the study of pancreatic physiology. Previously much that was taught concerning the pancreas was based upon observations made in the laboratory upon various types of animals; the inference was that the facts thus gleaned in all probability applied to human beings. Recent surgical experiences however would indicate that human pancreatic physiology differs in certain respects from that observed in the several varieties of laboratory animals.

In a recent publication<sup>1</sup> dealing with the etiology of acute pancreatitis as observed in cats and produced by ligation of the main ducts and stimulation of the gland by feeding it is concluded that the most important factor is obstruction of the ducts. Neoplasms of the head of the pancreas or ampulla produce high grade obstruction of the ducts and these patients rarely exhibit concomitant acute

pancreatitis, although prior to operation the obstruction did exist and there was stimulation when the patients ingested food. Further more pancreatoduodenectomy without implantation of the transected neck into the jejunum is in effect a ligation experiment in man and the operation is not followed by acute pancreatitis when the patient recovers; the fistula is closed and the gland is stimulated by ingestion of food.

In the earlier phases of the development of pancreatic surgery the question was frequently asked by internists, physiologists, and others why the patients did not develop acute pancreatitis. Why they should be expected to do so is not clear but prior teaching certainly gave a widespread impression that there would be great hazard in surgical manipulation of the pancreas. It would appear that this complication is so unusual that no surgeon now hesitates to attack the pancreas for fear of acute pancreatitis.

In the experience of the writer operative trauma to the dog's pancreas is very well tolerated indeed, and attempts, by mashing the gland *in situ* to produce the homologue of the large posttraumatic pseudocysts in these animals that are observed in man following crushing trauma to the upper abdomen have been negative.

Another interesting observation in man has been the variation in character of the stool following complete occlusion of the external secretion as a result of pancreatoduodenectomy without reimplantation of the transected neck of the gland. The stools are fatty bulky and relatively frequent in some of the patients but by no means all of them. In one case there was steatorrhea and after operation where only the bile was returned to the alimentary tract the stools were normal. In another instance normal nutrition has been maintained for two years, in another for

<sup>1</sup>Lee, R., and Maddock, Stephen, *Surgery* 1943, 24, 932.

four years in a third for five and a half years<sup>2</sup> in still another patient eight years,<sup>3</sup> where the pancreatic juice has been completely occluded. A ready explanation is that accessory pancreases must exist to afford the external secretions but in the absence of final proof of this, other theories such as the presence of secretions from other parts of the bowel that sometimes can substitute for pancreatic juice, are just as valid and possibly more thought provoking.

<sup>2</sup>Brunschwig, A. *Lyon chir.* (in Press).

<sup>3</sup>Whipple, A. O. Personal communication.

The patients who have received total pancreatectomy afford excellent opportunities for study of carbohydrate metabolism in general. An example is the arresting observations that the totally depancreatized human requires relatively modest doses of insulin, less than in many of those who are spontaneously diabetic with the entire pancreas *in situ*. Furthermore total pancreatectomy in the diabetic subject does not result in appreciable increase in the severity of diabetes. These facts suggest new avenues for further study of diabetes mellitus in man.

ALEXANDER BRUNSCHWIG

# THE SURGEON'S LIBRARY

## REVIEWS OF NEW BOOKS

THE Swedish School of Radiology developed under the beneficent direction of the universally beloved Gosta Forssell has grown into one of the best radiological centers in the world, one which has contributed in a very large manner to the advancement of medicine in general and of radiology in particular. The new discoveries and techniques in radiology emanating from this school have been published in the various radiological journals, particularly in the *Acta radiologica* and the supplementary volumes of the *Acta* which have now reached more than sixty five in number.

The present series of lectures, *Röntgen Studies of the Lungs and Heart*<sup>1</sup> by Nils Westermark, M.D. delivered at the Center of Continuation Studies of the University of Minnesota at the instigation of Professor Leo G. Rigler, integrates anatomy, physiology, pathology and clinical medicine in the application and interpretation of roentgen diagnostic procedures most useful in the study of the heart and lungs. This is a valuable collection of dissertations very much worth study at the hands of internists, pathologists, cardiologists, and radiologists.

JAMES T. CASE

THE book *General Endocrinology*<sup>2</sup> by Turner was written primarily for students who are concentrating on experimental biology rather than for the practicing physician or medical specialist. The discussion of each gland includes comparable structures in lower vertebrates and invertebrates which greatly add to the value of the book. There is sufficient gross and microscopic anatomy to permit review of the important aspects of the glands. The review of developmental and comparative anatomy certainly adds to the interest and understanding. The biochemistry of each hormone and its physiological effects are well treated and finally the results of over or under secretion are touched upon. The interrelationship of the several endocrine glands has been sufficiently stressed. Perhaps one of the book's best features is the generous reference to the classical experiments which have been done in the various fields.

The bibliography at the end of each chapter is excellent as it contains all the important references on the subject.

<sup>1</sup>ROENTGEN STUDIES OF THE LUNGS AND HEART. SERIES OF LECTURES DELIVERED AT THE CENTER FOR CONTINUATION STUDIES, UNIVERSITY OF MINNESOTA. By Nils Westermark, M.D. Edited by Leo G. Rigler, M.D. Minneapolis: The University of Minnesota Press, 1944.

<sup>2</sup>GENERAL ENDOCRINOLOGY. By C. Donald Turner, Ph.D. Philadelphia and London: W. B. Saunders Co., 1944.

While this book was prepared chiefly for the student general medical practitioners and specialists in endocrinology will find it interesting and helpful. It is well organized and well presented and is recommended to all interested in medicine and its allied fields.

BROCK BAKER

THE present edition of *Recent Advances in Surgery*<sup>3</sup> by Harold C. Edwards is the third edition of a series formerly edited by Sir Henage Ogilvie, the last published in 1929. A volume of 495 pages, well printed with numerous illustrations, it will be found of great interest to the general surgeon.

There are seven parts. The first deals with the general problems of wound healing, shock, burns, fluid balance and antibacterial therapy. The second is particularly well done, on the alimentary system. There are notably good sections on the esophagus and on the rectum. The third part by R. C. Brock covers the thorax. The fourth by D. W. C. Northfield reviews the nervous system with a section on head injuries and another worth noting on intracranial aneurysms. The fifth is concerned with blood vessels and anticoagulants. The sixth summarizes the advances in the ductless glands, including prostate and breast. There is an illustrated description of Millin's operation for prostatic hypertrophy. The seventh and last part by Sir Stanford Cade is an excellent review of radiotherapy in malignant disease.

There is so much material that one may wonder how it is compressed. For example in the section on the thorax after a short introduction, the surgery of the heart is described, including wounds, foreign bodies, suppurative pericarditis, constrictive pericarditis, mediastino-pericarditis, congenital abnormalities, pulmonary atresia, angina pectoris, extra-coronary and intercoronary communications. A detailed chapter follows on bronchial carcinoma. And, at the end of each chapter an adequate list of references will be found. An index also follows at the end of the book.

This book is very readable and it can be recommended to those who would review these fields. It differs from our Year Book in that it covers a longer period and a smaller field. Referring to it one can be assured of a summary of the advances in each field and a list of important references.

JOHN L. ATLEE, JR.

<sup>3</sup>RECENT ADVANCES IN SURGERY. By Harold C. Edwards, C.B.E., M.S. F.R.C.S. 3rd ed. Philadelphia: The Blakiston Co., 1944.

TO those interested in the preparation and publication of scientific papers *Medical Writing*<sup>1</sup> by Morris Fishbein, Editor and Jewel F. Whelan, assistant to the Editor of the *Journal of the American Medical Association* will be found most useful. The book contains a wealth of valuable information and the very full index makes this information easily accessible. One might wonder why pains were taken to spell out the captions to Figure 12 B in the chapter on illustrations in letters so black and ungainly as to focus attention on them rather than on the drawing itself. Some of the rules given for the copy editing of manuscripts for American Medical Association publications might be considered arbitrary but the publications of the Association speak for themselves as to the high quality of the work the Association does. *Medical Writing* should be of great help to the doctor preparing a manuscript, to his secretary who copies it and to the copy editor whether or not associated with the American Medical Association.

M. E. SPENCE.

THE volume by Dr R. B. H. Gradwohl *Clinical Laboratory Methods and Diagnosis*<sup>2</sup> has increased in size with every edition until now in the fourth edition it fills three large volumes and more than 3,300 pages. It is encyclopedic in scope and modern in content. In addition to the chapters which describe all the tests which are performed in the ordinary day's work of a large hospital laboratory there are also comprehensive sections on electrocardiography, autopsy technique, toxicological methods and the detection of crime by laboratory methods. The entire three-volume work is written in collaboration with Dr Pedro Fouri of the Faculty of Medicine of Havana University is devoted to parasitology and tropical medicine and is noteworthy for the pictures illustrating the pathology of the various diseases.

The general plan of the book includes a detailed description of nearly all the modifications of the different laboratory procedures, which is followed by a discussion of the interpretation of the results. Frequent lengthy accounts of certain clinical and therapeutic aspects of the diseases under discussion are also included. A commendable feature is the detailed description of the various scientific instruments which are used in the laboratory. Each manufacturer's instrument, although frequently designed on the same basic physical or chemical principles, often requires minor but essential variations of operation and it is helpful to have these differences explained.

There is a good discussion of the cytological diagnosis of cancer of the uterus, bronchus and prostate by the methods of Papanicolaou, of Ayre and Dakin and of others followed by an even better evaluation

of the results of this method of diagnosis. The illustrations in this section of the book are especially fine and for the most part are reproduced from articles which appeared in *SURGERY, GYNECOLOGY AND OBSTETRICS*.

This book will undoubtedly be used constantly as a guide in many laboratories and should prove a ready aid to the experienced as well as the inexperienced laboratory worker. This reviewer however would like to suggest that future editions could be considerably shortened by critical editing of the material which is included in the book and the use of an economical literary style. Much chaff could be winnowed from the wheat.

WILLIAM B. WARTMAN.

THE sixth edition of *Recent Advances in Anesthesia and Analgesia*<sup>3</sup> by C. Langton Hewer was designed to present information regarding recent developments in anesthesiology. The small concise volume deals briefly with basic principles and new topics. Prominence is given to the use of curare and similar drugs as specific muscle relaxants. Numerous references are listed at the end of chapters and many illustrations of equipment are included.

Of particular interest are the chapters which take up psychological aspects and theoretical considerations of anesthesiology. Special attention is given to charts and records with emphasis on the card index systems. The discussion of trilete is of value as this nonflammable agent is little known in this country. The use of anesthesia in domiciliary practice is a field in which most American anesthesiologists lack experience. The author had extensive wartime work with cases of trauma, and his remarks regarding the administration of anesthesia to patients in shock are well worth while.

Considerable space has been devoted to mention of experimental infrequently used and obsolete drugs. The discussion of shock therapy quickly dismisses blood transfusion but provides a conspicuous list of analeptics. The use of ethyl chloride analgesia for short dental operations seems a hazardous procedure due to the cardiac effects of this potent drug. It is stated that nitrous oxide anesthesia is used extensively in the United States for major surgery; this secondary saturation technique has been discarded by most because of the anoxia involved.

The text is general in treatment and no technical details are given for the most part. The subject matter includes such fundamental topics as premedication agents and methods of anesthesia, apparatus, explosion hazards, oxygen therapy and anesthetic management of various types of surgical cases. The student will find the basic principles of anesthesiology briefly outlined. The specialist will note some points unfamiliar in American practitioners. However, the primary interest of this book is its presentation of the British viewpoint in the practice of anesthesiology.

<sup>3</sup>RECENT ADVANCES IN ANESTHESIA AND ANALGESIA. By C. Langton Hewer. 6th ed. Philadelphia and Toronto: The Blakiston Co., 1948.

MARY FRANCES POE.

<sup>1</sup>MEDICAL WRITING, THE TECHNIQUE AND THE ART. By Morris Fishbein, M.D. and ed. Philadelphia and Toronto: The Blakiston Co., 1948.

<sup>2</sup>CLINICAL LABORATORY METHODS AND DIAGNOSIS: A TEXT BOOK ON LABORATORY PROCEDURES WITH TESTER ILLUSTRATIONS. By R. B. H. Gradwohl, M.D. D.Sc., F.R.S.T.M. & H. (Lond.). Volumes 1-3. 4th ed. St. Louis: The C. V. Mosby Co., 1948.



AN amplification of the author's earlier book *Diseases of the Ear, Nose and Throat* by William Wallace Morrison includes the same type of anatomic and histopathologic line drawings which clarified that excellent text.

This is no exhaustive rebash of abandoned theories. It presents up to date findings and is documented with references to recent work at the end of each chapter. Valuable diagrams of endaural surgical procedures, including fenestration, excellent discussions of nasal allergy and of headaches and of tracheo-bronchial neoplasms, have been added. There is an extensive formulary of medicaments for patients, and a valuable symptom index.

As a guide for the general practitioner and a ready reference work for the specialist in this field Morrison's book cannot be surpassed.

RALPH A. FENTON

IN the third edition of *Essentials of Pathology*, A. Smith and Gault have maintained the standard of the two previous editions and have made a number of changes which are worthy of mention. The photomicrographs are clearer, more numerous, and are selected to demonstrate the more common lesions. A similar comment may be made about the photographs of gross specimens and the roentgenograms. It is suggested that the colored plates on malarial parasites, the various cells of the hematopoietic system, and the eye grounds could be supplanted by colored plates of true pathologic changes. The former ones are ordinarily seen in manuals of clinical medicine.

Discussion still continues on the use of the case method of teaching. Since it remains of questionable value in teaching pathology the authors are wise in condensing the case histories used in this volume. Many unnecessary words and phrases have been eliminated without detracting from the clarity of the explanations.

A proper increase in the amount of space allotted to neoplasms has been made. The sections on the bacterial and the parasitic diseases are still the best in their respective divisions of any of the commonly used texts of pathology. In a future edition there could be added chapters on the pathology of skin and of the special senses. This would enhance its value and enable the student to be grounded in the pathologic changes of the more common entities seen in these specialties. Consideration might also be given to the possible inclusion of a section on radiation effects.

The two column format of the printed page makes reading less fatiguing, more accurate, and more rapid. This volume may be wisely used by the student and practitioner either for preliminary study or as a review of the fundamentals of pathology.

MARK WEEKLOCK.

*DISEASES OF THE EAR, NOSE AND THROAT*. By William Wallace Morrison, M.D. New York: Appleton Century Crofts, 1933.

*ESSENTIALS OF PATHOLOGY*. By Lawrence W. Smith, M.D. F.C.A.P. and Edwin S. Gault, M.D. F.C.A.P. 3rd ed. Philadelphia and Toronto: The Blakiston Co. 1933.

CHRISTOPHER'S *Minor Surgery* is so well known and so widely used that little needs to be said concerning the general content of the volume. The scope of the book, according to the preface is the consideration of the pathogenesis, diagnosis, and treatment of conditions which are included in the surgical operations performed by the general practitioner by the physician who does not have ready access to large hospitals or contact with specialists in surgery and by the physician who was unable to serve the long apprenticeship necessary for the practice of surgery. A sincere effort has been made to avoid provincialism. Direct quotations are used extensively, an excellent method by which to present the ideas of experts in a particular field and, as the author points out, the fairest method of giving credit to these men. In addition the method serves admirably to introduce many leaders in surgery through some of their best work to surgical intern and resident.

The first three chapters deal with wounds and infections, and the succeeding four chapters deal with burns, foreign bodies, injuries by electricity and circulatory disturbances. Subsequent chapters discuss injuries, infections, deformities and tumors of the head, neck, trunk and extremities. The male and female genitourinary organs are covered in separate chapters and the valuable sections pertaining to preoperative and postoperative care, minor surgical technique, and the duties of the surgical intern have been retained.

One might be somewhat skeptical as to the necessity of another edition four years after publication of the fifth edition but in reading this volume the reviewer concluded that the sixth edition is amply justified by the author's continued effort to supply information of latest advances and most approved methods of treatment. The length has been increased by approximately fifty pages. The paper typography and binding are excellent, as are most of the illustrations. References have been moved from footnote position to the ends of the various chapters. The incredible number of references is a gauge of the extensive coverage of the field and the merit of the volume is greatly enhanced by the bibliography. For example there are 451 references, designated by number in the chapter on open wounds. The criticism may be carping but with references at the end of the chapters, one would prefer to have them arranged in alphabetical order. While this edition has been extensively revised, the general format remains unchanged.

As would be expected, in fields in which considerable progress has been made extensive revision has been necessary and several new sections have been added. The discussions of antibiotics and sulfonamides have been greatly expanded, as have the sections on thrombophlebitis, phlebotrombosis, burns, varicose veins and pilonidal cysts. New material, in this edition, includes information concerning gland

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The sixth edition with revisions and additions of material is the best book in its field.

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FOR his recent book Dr. Walter has taken the same title which Schimmelbusch used in 1893 namely *The Aseptic Treatment of Wounds*.<sup>1</sup> The difference in the size and scope of these two books is indicative of the progress that has been made in this field in the last 56 years. The introductory chapters show graphically the contributions made during the overlapping careers of many different men and the gradual evolution of the philosophy of asepsis over a period of two hundred years from Charles White to Johann von Mikulicz Radecki, the former stressing cleanliness and isolation and the latter emphasizing the importance of masks and gloves and the dangers of wound contamination from the air.

Dr. Walter has brought to this problem his early technical training which he has applied to the mechanics of sterilization of dry goods instruments, solutions may more the whole environment of the operative field. He has stressed the belief that the surgeon himself should understand these principles, in order that he may direct and control these processes rather than turn the responsibility over to a constantly changing personnel among his assistants. However the book is written not only for the surgeon but for the technical assistants in the operating room so that they too may understand the necessity for the minutiae of detail required to prevent the entrance of bacteria into the wound of the patient particularly those which may come from the mechanical devices involved in sterilization.

In his delineation the author is greatly aided by the excellent line drawings of his co-author Mildred Coddington who with keen understanding follows through the steps of the preparation of the patient, the personnel and the sterile field clearly illustrating the closing and opening of laparotomy kits, surgical drapes surgical gowns pads, masks and the arrangements of instruments.

The book stresses the importance of the controls required to make foolproof the steam sterilization both for routine and emergency work and the care of the instruments both before and after this procedure. The rationale of the surgical scrub-up both for the doctors' hands and for the operative field is thor-

oughly explained. The dangers of contamination by air borne bacteria are carefully considered with special reference to the bacteria which are brought in by the operating personnel on their clothing and shoes and particularly in their noses and throats, from which organisms can so readily be distributed to the sterile field or into the wound where they may grow rapidly because they have come so recently from a similar human environment.

In the operating room technique itself Walter stresses the importance of team work and here Mildred Coddington comes to his aid with innumerable illustrations which should be of great value to any operating room staff which desires to work with optimum efficiency and safety.

The book lays special stress on the terminal sterilization of instruments and textiles from septic cases which are potential sources of bacterial contamination. Their care is often neglected in many hospitals. Contamination from this source can be reduced to a minimum by the intelligent application of the principles involved. This danger can be controlled almost single handedly by a conscientious scrub-up nurse.

Dr. Walter goes into the necessity for great care in the preparation of parenteral fluids including blood and plasma and the importance of the avoidance of reactions from the administration of these fluids.

The author also emphasizes the value of carrying the principles of asepsis into the wards where daily dressings are done, in order to avoid the spread of infection from one patient to another and the transfer of organisms from patients to attendants and attendants to patients. This also is an important phase of asepsis which is often neglected. It has recently been re-emphasized during the war period when soldiers were brought into hospitals in great numbers carrying with them the contamination from the fields of battle as well as the organisms causing nonsurgical communicable diseases.

I have no hesitation in saying that this book should be part of the equipment of every hospital operating room and be read and understood by every surgeon and his assistants. FRANK L. MELENEY

IN these days of schools of psychiatry with each group supported by zealous followers who believe that only their method is correct, it is difficult to prepare a book of psychiatry which would not be confusing to the uninitiated. Certainly the medical student, completely unaware of different philosophies and ideologies in a rapidly expanding specialty can develop no well organized concept of human behavior and its aberrations when this difficult subject is presented from so many different angles.

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<sup>2</sup>MODERN CLINICAL PSYCHIATRY. By Arthur E. Noyes, M.D. 3d ed. Philadelphia and London: W. B. Saunders Co., 1942.

biology but he reviews all the earlier contributions of Kraepelin, Bleuler, Janet, and finally culminates in a complete objective evaluation of the psychoanalytical theory of behavior and its applicability in therapy. The different spheres of thought are handled in such a way as to leave the student clear as to what is definitely established.

At the same time the practical aspect of the applicability of the various regimens of treatment is not lost sight of. The book contains comprehensive chapters on institutional care, special procedures like hydrotherapy, occupational therapy, recreational therapy and psychotherapy, plus the more recent methods of insulin and convulsive shock therapy. The treatment of neurosyphilis by fever and penicillin is discussed comprehensively. Even frontal lobotomy is evaluated. A chapter is included on psychosomatic medicine in which the relationship of psychiatry to

general medicine is well delineated. Psychotherapy is reviewed in its various disciplines. The closing chapter is on child psychiatry which gives the reader an idea of some of the disturbances that may be encountered in the young.

All in all the author covers the field of psychiatry in a broad manner. His own experience and background are such as to enable him to have a mature opinion about the various techniques of the care of the mentally ill, and with many of the therapies like shock therapy and the fields of psychotherapy beginning to come of age, an objective measure can be made and is presented.

I enjoyed reviewing this book and can recommend it for medical students and for general practitioners. It is a book that could well be frequently used by every psychiatrist no matter what his personal philosophies. BENJAMIN BOESER.

## BOOKS RECEIVED

Books received are acknowledged in this department, and such acknowledgment must be regarded as a sufficient return for the courtesy of the sender. Selections will be made for review in the interests of our readers and as space permits.

LIVES OF MASTER SURGEONS. By Richard A. Leonardo, M.D. Ch.M., F.I.C.S. New York: Froben Press, Inc., 1948.

CONSTRUCTED REFLEXES AND NEURON ORGANIZATION. By Jerzy Konorski. Translated from the Polish under the author's supervision by Stephen Garry. Cambridge University Press, New York: The Macmillan Co., 1948.

L'ANOMALIE FRONTALE RETRO-FUSION. By R. Courvillat. Paris: Editions Bernard Bouchet, 1948.

HEMATOLOGY. By Cytes C. Sturgis, M.D. Springfield, Ill.: Charles C. Thomas, 1948.

SURGICAL PATHOLOGY. By Peter A. Herbst, M.D. Philadelphia: Lea & Febiger, 1948.

ENDOGENOUS ENDOCRINOGRAPHY INCLUDING THE CATABOLIC CANCER CONCEPT. By Jules Samuels, M.D. Amsterdam, Netherlands: Hokert & Co., 1948.

APPREHENSION MEDICALE ET CHIRURGICALE DU FORD. By Raphael Massart. Paris: G. Dolin & Co., 1948.

PATOLOGIA DA GESTACAO. By Professor Raul Briquet. Sao Paulo: Editora Renascença, S.A., 1948.

AN INTRODUCTION TO GASTRO-ENTEROLOGY. By Walter C. Alvarez. 4th ed. New York: Paul B. Hoeber Inc., 1948.

EMERGENCY SURGERY. Parts and 2. By Hamilton Bailey, F.R.C.S. (Eng.), F.A.C.S., F.I.C.S., F.R.S.E. 6th ed. Baltimore: The Williams & Wilkins Co., 1948.

THE CLINICAL MANAGEMENT OF VARICOSE VEINS. By David Woodford Birtow, M.D. With foreword by Arthur W. Allen, M.D. New York: Paul B. Hoeber, Inc., 1948.

HISTOPATHOLOGY OF THE PERIPHERAL AND CENTRAL NERVOUS SYSTEMS. By George B. Hamlin, M.D. 3d rev. ed. Chicago: The Author, 1948.

CLINICAL UROLOGY ESSENTIALS OF DIAGNOSIS AND TREATMENT. By Lowthian E. McCrea, M.D. F.A.C.S., F.I.C.S. 2d ed. Philadelphia: F. A. Davis Co., 1948.

PREMATURE INFANTS, A MANUAL FOR PHYSICIANS. By Ethel C. Dunham, M.D. Washington: Federal Security Agency Children's Bureau, 1948.

CONTROL OF PAIN IN CHILDREN. By Clifford B. Leif, M.D. F.A.C.S., F.I.C.S. and Robert A. Hinson, M.D. F.I.C.S., F.A.C.S., F.I.C.A. With an introduction by Norris W. Vasey, M.D. 3d ed. Philadelphia: J. B. Lippincott Co., 1948.

POSTURE AND NURSING. By Jessie L. Stevenson, R.N. P.T. 2d rev. ed. New York: Joint Orthopedic Nursing Advisory Service of the National Organization for Public Health Nursing and the National League of Nursing Education, 1948.

ATLAS OF HUMAN ANATOMY: DESCRIPTIVE AND REGIONAL. By M. W. Woerdeman, M.D. F.R.N.A. Sc. Vol. — OSTEOLOGY, ARTHROLOGY, MYOLOGY. Baltimore: The Williams & Wilkins Co., 1948.

TEXTBOOK OF GENITO-URINARY SURGERY. Edited by H.P. Winsbury-Wilks, M.B., Ch. B., F.R.C.S. (Edin.), F.R.C.S. (Eng.). Baltimore: The Williams & Wilkins Co., 1948.

THE PARATHYROID GLANDS AND METABOLIC BONE DISEASE, SELECTED STUDIES. By Fuller Albright, A.B., M.D., and Edward C. Reifenstein, Jr. A.B., M.D. F.A.C.P. Baltimore: The Williams & Wilkins Co., 1948.

THE MODERN MANAGEMENT OF GASTRIC AND DUODENAL ULCER. Edited by F. Cronin DeBor, M.D. M.R.C.P. Baltimore: The Williams & Wilkins Co., 1948.

THE FRONTAL LOBES, PROCEEDINGS OF THE ASSOCIATION FOR RESEARCH IN NERVOUS AND MENTAL DISEASE. Edited by John F. Fulton, M.D. Charles D. Aring, M.D., and S. Bernard Worth, M.D. Vol. 27. Baltimore: The Williams & Wilkins Co., 1948.

THE SURGERY OF THE STOMACH AND DUODENUM. By T. H. Somerville, M.A., M.B., B. Ch. (Cantab.), F.R.C.S. (Eng.). Baltimore: The Williams & Wilkins Co., 1948.

TECHNIQUES CHIRURGICALES VAGINALES. By Eric Weber. Paris: J. B. Baillière & Fils, 1948.

February, 1949

# SURGERY GYNECOLOGY AND OBSTETRICS

*Supplement*

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# INTERNATIONAL ABSTRACTS OF SURGERY

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## COLLECTIVE REVIEW

### VENOUS OBSTRUCTION IN THE UPPER EXTREMITY (PAGET-SCHROETTER'S SYNDROME)

#### A Review of 320 Cases

E. S. R. HUGHES M.D., M.S. F.R.C.S (Eng) London England

**I**N 1875 a series of lectures that had been delivered by Sir James Paget was published in the course of one of these entitled Gouty Phlebitis, he described 2 cases in which the clinical features, he believed were attributable to a thrombosis of the main veins of the upper extremity (151)

A man about 50 years old, thin and moderately muscular and usually healthy observed, during a September that his right arm was growing larger and as he thought, stronger, and fitter for work. But, as it still increased, it became inconveniently heavy, and certainly weaker and then he applied for advice. I found the upper arm two inches more in circumference than the left, and the whole limb enlarged in the same proportion. It looked full, round, and muscular and felt firm, and oedematous, not only in the subcutaneous tissue but throughout the skin was tense, cool, and pale. In nearly four inches of its course the axillary vein felt large, hard, and cord-like and in one or two spots over it pressure caused pain but with this exception no pain was felt in any part of the arm. Some of the superficial veins in the arm, and over the upper and front part of the chest were enlarged, and when the arm hung down for a long time the hand became dusky. No cause whatever could be traced for this condition. No injury or pressure no known inheritance of disease no disturbance of the general health, past or present.

With the help of hot douche, warmth, and friction the swelling of the arm very gradually subsided and, as it did so, the cord like feeling of the obliterated axillary vein became more distinct. A year elapsed before the vein regained its completely natural condition but it has now for more than five years been well.

Honorary Surgeon, Connaught Hospital, London and a Leverhulme Scholar of the Royal College of Surgeons of England.

Very similar to this case was that of a regimental ser-  
vant, 37 years old, previously healthy and very active, who was sent to me on April 25th 1885 by Mr. Bossey on account of the condition of his right arm. This was swollen and when it hung down, he had a feeling of weight and fulness as if the blood could not return from it. The arm was, indeed, about a quarter or a third larger than the other but its chief enlargement felt as if due to great muscular development. Besides this, however it had probably some general swelling which might be from slight oedema of its deeper tissues, its subcutaneous veins were all overfull there were small bluish spots over the deltoid, as if from small clusters of varicose veins, and the veins over the right pectoral muscles were fuller than those over the left. This condition of fulness extended as high as the deltoid's origins the shoulder especially was remarkably broad and large, and there were fulness and some prominence of the upper part of the right great pectoral. The heart's action and sounds were natural so was the pulse at both wrists, equal and moderately full. It was uncertain how long this state of the arm existed. It had been observed only a week its rate of increase was unknown. The patient remained in about the same condition till May 4th, when he was taken into Hospital, and ordered milk diet six leeches every third night and three grains of Mercury with chalk every night and morning. He was under this plan for about a fortnight, and certainly improved, the arm decreasing, and its veins becoming less full. Then he had an attack of scarlatina, and while this was running its course all signs of the affection of the arm disappeared. It regained its natural size the veins were scarcely fuller than in a healthy man he lost the sensation of numbness, and he believed himself well at the end of May.

In 1884 von Schroetter reported a similar happening in the right arm of a healthy painter who was working at the time of the onset. Schroetter believed that the axillary vein was damaged and

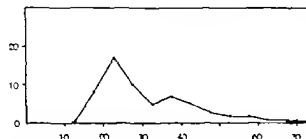


Fig. 1. Age of patients in years. The graph rises abruptly to its highest level between 20 and 25 years. The incidence gradually declines and relatively few cases are seen after the age of 50 years.

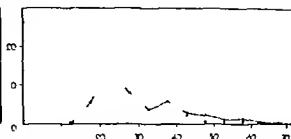


Fig. 2. Relation of age in years to sex. Males—Females. There is no significant difference in the ages at which the two sexes are affected.

was subsequently obstructed by a thrombus. Damaschino is said to have studied a similar case 3 years later. These cases are to be distinguished from the one described in 1894 by Letullo and Meslay in which thrombosis of the subclavian and internal jugular veins complicated extensive carcinoma and from those reported by Bouchut, Humphry, Meslay and others in which thrombosis of the subclavian and axillary veins occurred in the terminal stages of advanced cardiac failure.

No further cases of the type described by Paget and Schroetter appeared in the literature until 1910 and 1911 when Schepelmann (189-190) published his observations on a boy of 22 years who developed pain and swelling in the left arm following overexertion controlling high spouted horses. Ruge and Unger both gave an account of cases in Germany in 1911 and at the Fortieth Congress of Surgeons in Berlin in the same year Heinecke reported 3 cases while Rosenthal added 2 more the following year. German authors continued to show considerable interest in the syndrome further examples were published by Baum, Hollander and Finkelstein. Loehr reviewed the literature in 1929 and added 6 more cases (124) and more recently several large series have been reported (82, 125, 212, 222).

In France, Layrol described a case in 1911 and in 1913 there was considerable discussion on a number of patients presented at the Paris Surgical Society (22, 45, 141, 164, 174, 181, 193). Further cases soon followed and by 1932 Cottalorda was able to publish a long review but relatively few have since been reported in the French literature.

In 1913 Gautier reported 2 cases in Switzerland and he quoted a thesis written a year earlier on the subject by a compatriot, Madame Bogdanoff. Winterstein added 4 more cases in 1925 reviewing the literature at the same time. Vossenaar described a case in Holland in 1913 and Goudsmidt reported another some years later. In Scandi-

navia, the first cases were published in 1929 and 1932 by a Dane, Thomsen (202, 203), while Ljunggren, from Sweden, reported a third in 1936. Excellent reviews have recently been published by Roehen of Denmark (177, 178).

Professor Ranall, of Pisa (1849) has been accredited as the first to suggest "effort" as a cause of thrombosis (161, 204). Carere discussed the condition in 1911 and several comprehensive reviews have been written by his Italian colleagues, Pinelli, Paggi (153), Piccagli, Tomasi, and Pozzi.

The first cases to be reported from South America were those of Chutro of Argentina, in 1914 and 1915 (32, 33). In 1920 Pavlovsky gave an account of 3 cases, and 3 more were reported by Ivanissevitch (94) 2 years later. In North America, Wilson described 2 cases in 1922, while Lowenstein in 1924, made the first real attempt to find the solution to the problem of etiology. In recent years the condition has aroused much interest in the United States.

Willan discussed the cases of 3 patients in 1918, and 10 years later Gould and Patey (70) reported 8 more in London and described some original work on the subject. However the syndrome has never excited much attention in Great Britain and relatively few cases have been described.

#### TERMINOLOGY

The uncertainty which surrounds the etiology and even the pathology of this condition is reflected in the varied terminology. Most authors have used the terms "thrombosis" or "primary thrombosis of the axillary (subclavian) vein. Those who are impressed by the possible etiological significance of injury to the vein, have termed the lesion "traumatic," "strain," or "effort thrombosis," while others have preferred to add the prefix "so-called," for example "so-called traumatic thrombosis."

Loehr (125) has suggested that the term "intermittent venous claudication" is as apt as any

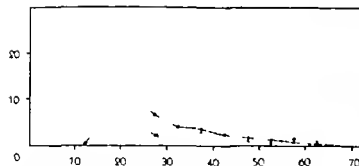


Fig. 3. Relation of the age in years to the side affected. Right—Left. There is no significant difference between the ages at which the two sides are affected.

other and this has been supported by other German writers. But Hauge believes it to be inaccurate because recurrence of symptoms after exercise is more probably due to inability of the collateral circulation to deal with the increased volume of blood rather than to any intermittent obstruction. He suggests that the condition be termed 'venous stasis'. MacCarthy has described his case as traumatic venospasm and there is no doubt that this was a feature of his case, but this has been unproved in the majority of cases, and does not appear to be the underlying factor in any case. Acute (subacute) oedema of the arm is a most unsatisfactory term.

The association of a more or less acute venous obstruction in the upper extremity of an otherwise perfectly healthy person constitutes a syndrome which in the absence of accurate knowledge of the etiology and pathology can be called the 'Paget-Schroetter syndrome,' after the first two to describe it as a clinical entity.

#### CLINICAL FEATURES

**Age.** Buxton stated that he had seen the condition in a patient of 75 years of age but gave no other details. Gautier reported it in a man of 72 years; this patient appears to have been perfectly healthy although he had a positive Wassermann reaction. Moure's case (142) was that of a woman of 71 years who developed a subclavian thrombosis after sustaining a fractured clavicle which gave rise to a fatal embolism 4 days after the injury. It is doubtful if either of these last 2 cases can be rightfully included in the disease under discussion. Salmon and Audier reported a patient of 70 years, Lenormant and Mondor one of 68 years, while Stover and Herrell, and De Bakay, Ochsner and Smith have had instances in people of 66 years. On the other hand the youngest patient so far observed has been a girl of 11 years, observed by Rosenthal, in whom the onset followed a very light game with a ball. Lapeyre has seen a boy of 14 years affected after carrying a

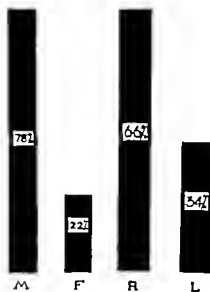


Fig. 4.

Fig. 5.

Fig. 4. Sex. Males are affected in 78 per cent of the cases, females in 22 per cent.

Fig. 5. Side. The right side is affected in 66 per cent of the cases, the left in 34 per cent.

heavy bucket of water. The onset has been noted on occasions, in children of 15 years (43, 209) and 16 years (43, 159) while several authors have had 17 year old patients (92, 132, 150, 154, 155, 158, 164, 178, 201, 220) (Fig. 1).

**Sex.** The predominance of the male sex has been recorded by all reviewers. All 3 of Willan's patients were males as were the 3 patients in the cases published by Heinecke and Pavlovsky (155), Kinzel, Loehr (125), Kux, Kaplan (101) and Morton each reported 4 cases, in all of which the patients were males, as were all 8 in the cases reported by Gould and Patey (70). Seven of the 8 patients in Zehnder's series, 6 of the 7 in Herlyn's, and 5 of the 6 in Barker's were males, and there was only 1 female in each of the series of 5 reported by Wagner and Sampson (184).

On the other hand 5 of the 7 patients in the cases published by Roelsen in 1939 were females (177) and 3 of the 7 patients seen by the same author in 1944 were also females (178). Three of the series of 5 cases published by both De Bakay, Ochsner and Smith, and Hughes were those of females, as were half of those reported by Loehr (124) and Hunter. Both of Clute's and both of Goudsmit's patients were females. The relative incidence of males and females is shown in Figures 2 and 4.

**Side.** The right arm is involved more frequently than the left (66%). This was conclusively demonstrated in Paget's review in 1933 (153) and apart from a few exceptions (25, 53, 78, 80, 124



125 133 145) is further exemplified in the individual series that have been published. As a result of this right-sided predominance, it has been suggested (209) although incorrectly that whenever the left arm is affected the patient is left handed or has used the left arm in some unusual manner. For example, Schepelmann's patient is said to have used his left arm to control the horses and Winterstein who had 2 such instances in his series pointed out that 1 occurred in a weaver whose work involved extra strain on his left arm, and the other occurred in a man engaged in lifting heavy bales of cloth who used his left arm more than his right. The relative frequency with which the two sides are affected is demonstrated in Figures 3 and 5.

**Onset.** The clinical features are characteristic when the condition has fully developed, but the initial symptom and mode of onset show some variation.

1. The arm becomes swollen in 57 per cent of the cases, sometimes slowly but more often rapidly and occasionally quite suddenly. This is accompanied by a sensation of tightness and of fullness and the limb feels heavy and stiff.

2. In 34 per cent of the cases the first symptom might be spontaneous pain in the arm or shoulder or it may be perceived only on movement; there is sometimes a sensation of undue fatigue in the arm.

3. In 6 per cent of the cases there is discoloration, or prominence of the veins in the arm or on the chest wall.

4. Two per cent of the patients on performing a movement have suddenly experienced a peculiar sensation in the shoulder or arm as if something had given way or "snapped" (114, 128, 150 171 211).

5. Two patients experienced *paresthesia*, a tingling sensation in the arm, immediately prior to the development of the typical clinical features (50, 114).

6. In 1 of Roelsen's cases the first symptom was pruritus in the affected arm (178).

7. Routhier's patient complained of a sudden onset of "paralysis" of the left arm while Barker, Kux, and Unger have noted weakness as an initial symptom.

In some cases the onset is acute and in others quite gradual; a sudden onset may occur in patients unexposed to any provocative activity while a gradual development occurs after an apparently definite causal trauma. Whether the onset be sudden or gradual, the first symptom may be either pain or swelling. Veal and Hume (207) believed that a gradual onset was nearly always

due to malignancy with initial symptoms of slight enlargement of the arm and unusual fatigability. This appears to be an oversimplification because in many of the cases reviewed the condition developed insidiously without any evidence of malignancy at all. Moreover, many patients noticed aches or pains in the shoulder or arm for some days prior to the appearance of the swelling and discoloration. Nor can one agree with Goldberg and Foley and others who believe that it is atypical for the onset to be gradual and unaccompanied by pain.

In 39 instances (13% of the number in which the onset is described) the patient awoke to find that the arm was swollen or blue, or ached or felt heavy.

**Swelling.** This has been noted in every case but 2 (40 195) and it is doubtful whether these 2 cases should really be considered as examples of the condition. In some cases the swelling only becomes apparent after the performance of some form of exercise. The whole arm is affected, from finger tips to shoulder and usually the swelling spreads on to the chest wall and may extend into the neck (136). Even in cases in which the swelling is considerable, pitting with the thumb is frequently impossible because of its firm nature. It might begin quite insidiously and even remain unnoticed by the patient until pointed out by an other or until the sleeve of a garment or a ring can no longer be worn. In Paget's first case the patient observed that "his right arm was growing larger and," as he thought, stronger and fitter for work. On the other hand, as Matsuzaki and De Bakker Ochsner and Smith (43) have emphasized, an occasional feature of the syndrome is the rapidity with which the swelling spreads over the arm.

Extreme distention of the veins must largely account for this swelling; such venous overfilling is easily demonstrated by the distended appearance of the superficial veins, by their failure to collapse on elevation, and by the marked rise of the venous pressure. Excessive interstitial fluid plays a less important role, although it may be the chief factor; for example, in some cases the swelling is soft and compressible and some surgeons have noted a considerable drainage of fluid from incisions in the arm.

**Pain.** This is a variable symptom and may never be present (67 72 178 207 215). The swelling frequently causes a dull ache in the arm, which is usually mild but may be severe such "tension" pain is diffusely referred over the whole of the arm. In some cases, pain is localized to the region of the shoulder girdle particularly the

axilla (118 177), in these circumstances it probably originates from the primary lesion itself whether it be complicated by a thrombus or not. When a thrombus exists and propagates itself along the brachial vein it may be followed by pain referred to the medial side of the arm (215). Sometimes the patient experiences pain often intense only after exercise of the arm this being presumably due, partly to a retention of metabolites and in part also to the swelling that the exercise provokes. The second case reported by O'Regan was unusual in that the pain was situated high up on the right side of the chest and was aggravated by deep breathing this was shortly followed by the appearance of the signs of venous obstruction in the right arm.

**Discoloration.** The arm develops a cyanotic hue although occasionally it becomes red or pink (64, 84, 101 178) and may even become white (189). This discoloration which is nearly always to be observed at some time during the illness, is usually diffuse but may be mottled (63 131 158). Roelsen (177) noted in one of his cases that even before the onset of the disease the hands became blue and black in cold weather. Bruising of the skin has been observed and Roelsen (178) described the appearance of 'phlebectasis'.

**Venous distention.** Almost without exception the disturbance in the circulation has been reflected in the superficial venous system. These veins become engorged and previously unnoticed veins about the shoulder and neck become apparent as the circulation develops through collateral channels. These distended collateral vessels may be the first evidence of the disease (37 70 177 178) and are usually apparent at the initial examination although excessive subcutaneous tissue or considerable swelling may obscure them at first. Sampson, Saunders and Capp (185) have reviewed the anatomy of the superficial veins of the thorax which are involved. There is a group of veins which stretches between the cephalic (and sometimes the basilic) and the external jugular veins, passing across the clavicle and upper part of the chest. A second group passes inferiorly over the thorax and connects the axillary or basilic veins with those of the abdominal wall, including the musculophrenic venae comitantes. This connecting channel is constituted by the lateral thoracic vein external mammary vein, mammary subareolar plexus and epigastric veins. This second group anastomoses with the first and also with the venae comites of the internal mammary artery of both sides.

**Paresthesia** The pins and needles sensation and tingling have been experienced by a few patients

but there is no particular distribution. One of Roelsen's patients complained of paresthesia in the hand (177). French's patient noticed tingling in the finger tips, while one of Willan's patients referred the sensation to the palm and thumb when the arm was held in certain positions. A patient observed by Rixford experienced tingling in the arm immediately after the onset and another numbness in the hand at night, while Roelsen's second patient in his 1944 series only experienced the sensation after the venography wound in the cubital fossa had suppurated (178). Horton's patient developed tingling in the arm after lying on it another of Roelsen's patients felt pins and needles in the arm when it was dependent (177).

**Pruritus** Roelsen (178) reported the case of a man of 35 years who rubbed his right arm to relieve a persistent itchy sensation within a very short time the arm was found to be diffusely swollen and discolored with distention of the superficial vessels.

**Movements** Wilson described complete paralysis of the muscles in the affected arm in both his cases and attributed it to pressure on the brachial plexus by a thrombus. Others have found varying degrees of temporary paralysis (22 26 77 122 129 134 143 144, 160 164, 181) but such observations lose much of their significance without uniform expression of muscle power.

The passive movements of the limb are generally unrestricted but there may be some limitation as the result of pain and swelling.

**Palpation** Many authors have found abnormal conditions on palpation of the axilla, and it seems certain that a thrombosed vein is sometimes if not frequently the responsible factor. Gould and Patey (70) noted that the axillary vein felt like a cord from its commencement to the clavicle. Gerster found a cord like structure very firm fixed, immovable mass 2.5 cms in diameter which could be followed for about 6 cms. Hauge described the axillary vein as 'feeling like a cord thick as a pencil and increasing to more than the thickness of the finger at the upper part of the shoulder insensitive'. Ivanissevitch, McGoogan and Simmons and Kaplan (101) palpated hard tender cords in the axilla which could be traced down the arm to the midforearm, and occupied the track of the brachial, basilic, and median basilic veins. Although most writers have described a cordlike thickening in the axilla both Guyott and Jeanney and O'Regan found localized mobile tumors of small size and tender on pressure. It is possible that these were thrombi as believed by the authors. On the other hand Cottalorda found no thrombus at operation on one of his patients.

despite the fact that it was regarded as certain that such could be detected clinically. Roelsen (178) after careful investigation of his patients, evidently felt that it was a difficult matter to decide whether the vein was thrombosed or whether it was merely distended with fluid blood.

In some cases the axilla has been tender without the presence of any palpable lump (23 70 173, 184, 215) while French and Rixford have noted a delayed appearance of a cordlike thickening along the brachial vessels. Others have not been able to demonstrate any cord tumor or tenderness, although the other clinical findings are in every way similar to those in cases which possess positive signs (3 64 86 94, 101 103 128 131 138 141 158 177 183 184 186 200 215).

In a few cases there has been tenderness, and sometimes a lump in the supraclavicular fossa suggestive of thrombosis of the subclavian vein. In Lenormant and Mondor's case the external jugular vein appeared to be thrombosed (118) and Ditter and Walker describe a cordlike induration with a zone of slight redness but non-tender along the course of the cephalic vein.

**Venous pressure.** Increased venous tension exists in all cases, and on examination this is obvious from the engorged veins of the arm. Veal and Hussey (207) described a technique for measuring venous pressure accurately both in a state of rest and after exercise of the arm; this constitutes their exercise test. Hauge also utilized the abnormal rise of venous pressure on exercise in his "provocative test" he estimated the venous hypertension clinically.

The normal venous pressure varies from 5 to 12 cm. of water. In this syndrome, a very high venous pressure has been observed in the resting arm on several occasions. Kaplan (102) had 3 cases with a resting tension of 21 and 41 cm., respectively. Salmon and Audier, Greenfield and Roca and Luxaroli have also noted marked increases at rest.

In some cases the resting venous pressure has been only slightly elevated, but an exaggerated rise follows exercise. In Roelsen's 1939 series (177) one patient had a resting venous tension of 9 cm. on the affected side, a rise of 4 cm. above that on the normal side, but this difference increased to 21 cm. on exercise. A similar case was recorded by the same author in 1944 (178) and Wilkcutts and Shelburne reported a case in which the patient presented a difference of 3 cm. between the arms at rest, but after exercise the normal side rose to 9 and the abnormal to 37 cm.

Although this accurate estimation of the venous pressure is of considerable interest, the

procedure is for the most part unnecessary and should be reserved for the occasional case in which the diagnosis might be in doubt.

**Collapse of the veins on elevation of the arm.** Several authors have noted that the superficial veins empty slowly on elevation of the arm (48, 101 102, 150 184). Keener, Canty and Prevost, and MacCarthy found that they may fail to empty at all, while Kaplan (102) observed in one of his patients that some of the veins emptied but others remained distended.

**Circulation time.** The circulation time from the affected arm has been investigated by several observers. Calcium gluconate in a 10 per cent solution has usually been employed for this purpose. As might be anticipated, in every case investigated, the circulation time has been prolonged (37 48 72 101 102 158, 207 216).

**Oxygen saturation of the venous blood.** Veal and Hussey (207) found a lowered oxygen content of the venous blood in their patients, and this has been confirmed in other cases (72 86).

Cruikshank regarded the test of such importance that although there was neither swelling nor discoloration in his case, he believed that a diagnosis of axillary vein obstruction was justified because the oxygen saturation of the venous blood was only 43 per cent as compared with a normal of 70 per cent on the opposite side.

**Skin absorption time.** Salmon and Audier and Wilkcutts and Shelburne injected 0.2 c.c. of normal saline solution intradermally and noted its disappearance in 50 seconds from both the normal and the affected arms. They are the only investigators to record such a test in this condition.

These last three investigations, like the measurements of venous pressure are of undoubted value in a case in which the diagnosis might be obscure. However, as this is rarely the case their practical application is limited.

**Arterial pressure.** There is no clear agreement as to the state of the arterial tension in the affected arm. Bazy, Kaplan (102), Greenfield, and MacCarthy have noticed the radial pulse to be weaker but most observers have been unable to detect any difference. The blood pressure in the involved arm also shows no appreciable departure from the normal level in most cases. In one of Sampson's cases (184) the blood pressure was found to be the same in both arms, but in another the pressure on the affected side was 100/70 mm. of mercury while on the normal side it was 135/70 mm. of mercury, six days later there was still a depression although the pressure was approaching normal. Other au-



Fig 6 Normal venogram. The basilic, brachial, axillary and cephalic veins are well filled but the subclavian vein is visualized. The veins show localized dilatations above valves. Before terminating in the axillary vein, the cephalic vein exhibits a characteristic curve (due to the pectoralis minor muscles).



Fig 7 Normal venogram. The basilic, brachial, axillary and cephalic veins can be seen and the dye traced beyond the first rib into the subclavian vein (arrow). There are no valve dilatations. The distal half of the axillary vein is apparently narrow while more proximally it shows reduplication. The cephalic vein displays its characteristic curve.

thors have also recorded a lowered blood pressure in the involved arm (71, 89, 101, 103, 126, 139, 218). On the other hand Veal and Ifussey (207) have found that the sphygmomanometer reading is often from 10 to 15 mm. of mercury higher on the affected side and this is confirmed by the observations of others (39, 51, 131, 132, 136, 139, 175, 196, 218, 222). Clute and Rixford have both observed considerable differences between the readings from the two arms.

**Oscillometry.** The oscillometric index has been measured by a number of investigators but the readings have varied. The index may be increased (39, 101, 102, 177) or decreased (17, 37, 101, 103, 104) or there may be no detectable difference between the two sides (73, 74, 78, 101, 162, 177, 216). In one of Roelsen's patients a normal reading was observed at rest but during exercise the index became greater in the affected arm (177).

**Temperature of arm.** A rough clinical estimation of the temperature of the affected arm has been made by many, but very few accurate recordings have been attempted. Freidland and Farber, and Roca and Lazaroni have found the arm to be warmer when measured with the thermocouple, whereas Horton noted it to be from 0.2 to 1.0 degree C. cooler. Many writers have had the impression that the arm was cooler but others have found it to be warmer.

**Lenography.** Except on the rare occasions when a cervical rib (4, 83, 134, 162) an aneurysm of the aorta (119, 197) or some such other cause for obstruction to the venous flow from the upper

extremities has been detected by direct roentgenography, this line of investigation has been of surprisingly little value. Blood vessels are only displayed by such means when their walls are calcified so that it is necessary to employ radio-paque solutions as used in urography in which the iodine complex is organically combined and thus rendered comparatively inert. Other substances have been employed with equally good effect e.g. diodrast (102, 198) and colloidal thorium dioxide (16, 101). The author uses a 50 per cent w/v solution of pyelosis (diodone) which contains 49.8 per cent by weight of iodine.

One of the veins in the cubital fossa is selected for the injection. Andersson believes that injection into the median basilic vein results in the most satisfactory picture. This vessel courses proximally on the medial side of the arm and pierces the deep fascia at about the level of the deltoid tuberosity to join a vena comitans of the brachial artery; the resulting venous trunk after a short course is further augmented by the profunda vein before terminating in the third part of the axillary vein. Kaplan and Katz (103) and others prefer to use the median cephalic vein which runs up the lateral side of the arm into the groove between the deltoid and pectoralis major, pierces the clavipectoral fascia on the medial side of the pectoralis minor and finally enters the axillary vein, frequently in conjunction with the acromiothoracic vein. Others have selected the median cubital vein which connects the former two vessels and usually



Fig. 8. Normal venogram. The basilic, brachial, and axillary veins and the distal half of the subclavian vein are visualized (arrow). The dye shadow becomes thin about the site of entrance of the cephalic vein; the latter vessel is not seen.



Fig. 9. Normal venogram. The basilic, brachial, axillary and cephalic veins are easily seen, the distal half of the subclavian vein (arrow) is visualized. The third part of the axillary vein shows an apparent narrowing of its lumen. There is a localized dilatation of the first part of the axillary vein due to the valve which is present here.

communicates with the brachial venae comitantes.

A percutaneous technique is used, although Roelsen (178) and others have exposed the vessel when necessary. A 20 c.c. syringe with an eccentric nozzle is fitted with a 20 gauge needle and filled with the medium. The patient is recumbent with the arm held at 45 degrees abduction. As the dye is rapidly diluted an exposure is taken while the injection is proceeding, 5 c.c. being sufficient to display the veins; however to ensure visualization of a maximum number of vessels, a further exposure is taken immediately after the entire 20 c.c. have been injected. Finally a third exposure is made 30 seconds after the injection is completed to ascertain if any stasis of the blood stream exists.

Normal venograms show considerable variations but there is usually an even, although unequal, filling of the basilic, brachial, axillary and cephalic veins. The opaque medium gradually decreases in density and often disappears in the region of the clavicle because of its dilution by blood flowing in from large tributaries. The subclavian vein, therefore is frequently not visualized except in its third part. Several valves may indicate their presence by localized, uniform swellings of the veins (Figs. 6, 7, 8 and 9).

When venous obstruction is present, the injected solution enters the collateral vessels and, as one would expect, these are almost invariably well displayed in venograms of such conditions. The collateral circulation is usually most apparent on the lateral aspect of the arm and sometimes markedly so (67, 101, 103). It often extends well into the neck and is well displayed in the cases

reported by Hauge and Kaplan (103). The vessels may be markedly dilated and extremely tortuous (72, 101).

The basilic vein may not fill (178) it may be visualized in its lower portion only (37) or to the point where it pierces the deep fascia in the arm to join the venae comitantes of the brachial artery (16). Kaplan (101), Willcutts and Shelburne, and Bruce have noted distention of the basilic vein, most marked above the valves present in the vein. There is no constant appearance of the axillary vein. Stabins described it as "thread-like". Roelsen (178) observed that at the level of the axillary fold is an abrupt ending which continues as very weak and irregular streaks of contrast medium" and in a further case that "there is a poorly filled vein suggesting the axillary vein." Kaplan (101) noted a venous segment which appeared to be a narrowed axillary vein, and Perlow and Barth described a case with "abrupt narrowing of the axillary vein—the lumen is about one-eighth that of the distal portion of the vein and is irregular." On the other hand, in the second case of his second series Roelsen (178) observed partial filling of the basilic, brachial, and axillary veins with the dye lying as a thin coat along the walls of the vessels "the lumen is filled centrally by nonshadow-giving mass which can be followed as a cord in the brachial veins from the elbow to the inlet in the axillary vein and for some distance beyond." In another case the same author noticed a large defect in the same vein. Many writers have stated that they have been unable to visualize the axillary vein at all (16, 37, 67, 68, 101, 102, 103, 158, 178). Willcutts and Shelburne and Bruce observed dilata-

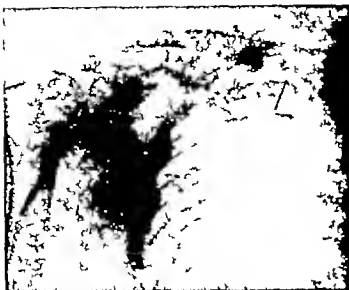


Fig 10 Venogram of recent case of venous obstruction. The cephalic vein is visualized and the dye can be traced from the termination of this vessel into the axillary vein as far as the middle of the subclavian vein. The basilic and axillary veins are not visualized. Collateral vessels enter both the cephalic and axillary veins. The dilatation of the cephalic, the presence of collaterals entering this vein as well as the terminal portion of the axillary vein, and the presence of dye in the subclavian vein all indicate obstruction in the proximal half of the subclavian vein. Thrombosis of the axillary vein, which may be present, is a secondary phenomenon due to stasis and intimal injury from overdistention.

tion of the vein presumably due to an obstruction at a higher level, while Mason, Hauge, and Pelter and Cohn claimed to have located the obstruction in the region of the first rib. Demel and Sgalitzer reported a case in which the venogram showed a slight indentation of the subclavian vein which they regarded as due to an apical lesion, while in another they could demonstrate contrast defects due to a thrombosis of the brachial and axillary veins, and partial thrombosis of the subclavian vein.

The median basilic or median cubital veins are injected although a separate needle into this vein may be required. Ditter and Walker visualized the whole of the cephalic vein in their case but at its termination it did not appear to empty into the axillary vein but assumed a collateral and devious course to enter the external jugular vein. Some have been able to demonstrate this vessel to the region of the clavicle (16 136 178) and others to the upper third of the humerus (67 103 158). Kaplan (101) visualized the vessel to the junction of the upper one third and lower two-thirds of the humerus at which point there were numerous collaterals on the lateral surface of the arm. A venous segment could be seen at the point



Fig 11 Venogram of a long-standing case of venous obstruction. The dye passes proximally by way of collateral vessels. The cephalic vein is tortuous and ends, not in the axillary vein but in a vein which crosses the clavicle to join the external jugular vein.

where the cephalic vein should enter the axillary vein. Roelsen (178) injected one patient 3 days after the onset, the median cubital vein was selected with the needle directed toward the basilic vein. All the solution ran back into the cephalic vein which filled and continued in a well developed collateral circulation in the deltoid region. The same author noted in 2 other patients that the vessel was much more distended than usual (Figs. 10 11 12).

The only constant feature of these venograms is the overdeveloped collateral circulation and Loehr (125) has emphasized that such cannot be taken as conclusive evidence of thrombus formation but rather of venous stasis. Roelsen (178) believes



Fig 12 Venogram of external jugular in recent venous obstruction. There is no evidence of obstruction to the external jugular vein indicating a more distal obstruction.



Fig. 3. Venous obstruction of the right arm.

there are several factors which account for the varying results. The time after the onset at which the venogram has been performed has varied widely and he believes that in some cases a thrombus may have undergone organization and recanalization leaving merely some minor changes in the wall of the vein, not able to give a characteristic picture." A thrombus localized to the subclavian vein, a lesion which cannot be verified radiologically will complicate preconceived ideas as to the interpretation of a venogram, and irritative factors may influence the configuration of the main vessels as well as the collaterals.

In one of Zehnder's patients there was no difference between the venograms obtained from the normal and abnormal arms while Roelsen (178) also had a normal venogram although there was some evidence of stasis.

It is difficult, in view of these findings, to agree with Stabins and others who claim that a venogram shows the site of obstruction and the adequacy or otherwise of the collateral circulation, and hence is a useful investigation. It may indicate where the obstruction begins but it is impossible to judge from the film either its extent or its cause. The efficiency of the collateral circulation is estimated much more satisfactorily by exercise tests and by observing the relation of the latter to the functional ability of the arm. Neither the diagnosis nor the selection of the correct treatment can be influenced by a venogram.

Roelsen (178) observed an aggravation of the swelling in 3 cases after a venogram had been carried out and attributed this to a chemical phle-



Fig. 4. Same case as in Figure 13 infra-red venography

bilis superimposed on the pre-existing stasis. Robb and Steinberg investigating a patient with a cardiac condition, injected diiodrast into the veins of an arm and this also was followed by an acute thrombosis of the main veins of the limb. Moreover complications (local or general) may follow the injection of any substance intravenously.

**Infra-red venography.** Superficial veins are clearly displayed by infra-red photography and the overfilled veins characteristic of this syndrome are well demonstrated (Figs. 13, 14, 15, 16, 17, 18).

**Constitutional disturbances.** Constitutional disturbances have been conspicuous by their absence. In fact, there is a considerable contrast in the appearance of the arm, swollen and cyanotic, and in that of the patient, in otherwise normal health. It is true that cases occur in which there is an associated constitutional reaction. For instance, McGoogan and Simmons reported the case of a woman of 42 years, suffering from chronic nephritis and toxemia of pregnancy, who on the fourteenth day after delivery developed axillary and subclavian thrombosis. This was believed, by the authors, to be due to the patient's pulling herself up by grasping the bar at the head of the bed. Her temperature rose to 99.6 degrees and her pulse to 140 and the latter continued to range between 120 and 140 for a week. Wilson recorded a temperature ranging between 99 and 104 degrees in one of his cases. However in the few instances in which the temperature was elevated, it was almost always a transient and very slight rise.



Fig. 15 Venous obstruction of the left arm

In McGooogan and Simmons' patient the tachycardia was extreme but usually the pulse is quite normal even when a mild pyrexia exists.

Several authors have reported cases with a very slight leucocytosis (74, 80, 84, 107, 129, 173) but this was not present in other patients, even those with fever. In no case have any other abnormalities been detected in the cellular content of the blood (except for those noted later and reported by the authors Winterstein and Stover and Herrell).

The blood sedimentation rate has been determined in some cases but it has nearly always been within normal limits (48, 78, 178). Roca and Lazaroni noted a very slight increase of sedimentation in a case 4 weeks after the onset. Roelsen (178) made a similar observation in 4 of his cases although in one of these the rise could be accounted for by suppuration of the venography wound.

#### DIAGNOSIS

The recognition of a state of venous congestion rarely if ever presents any difficulty. There is a rapid onset of a diffuse firm nonedematous swelling of the arm from hand to shoulder girdle with distention of the superficial veins and a reddish blue discoloration of the hand and forearm. The symptoms may quickly subside but tend to recur with exercise. Accessory investigations, such as venography measurements of venous pressure, and oxygen content of the venous blood, as well as oscillometric and skin temperature estimations, confirm the presence of this venous stasis if additional proof be needed but provide little or no information as to the cause.

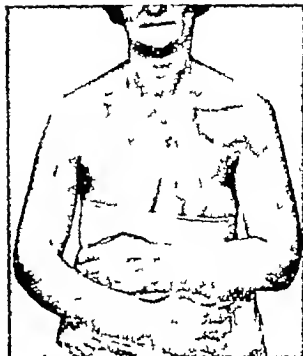


Fig. 16 Same case as in Figure 15. Infra red venography

Palpation of the axilla may reveal tenderness and frequently there is a thick firm tender cord occupying the course of the axillary vein. There may be some tenderness and even a cord in the supraclavicular region and down the inner side of the arm. A roentgenological examination is nearly always negative. The patient presents a healthy appearance without constitutional disturbances.

However, venous obstruction may occur in the upper extremity as a complication of certain easily recognized conditions.

**Cardiac failure.** Thrombosis of the main vessels of the upper extremity may complicate cardiac failure but this is rare. It was first described more than 100 years ago by Bouchut, subsequently by Welch, Blumer, and others, and more recently by Esselhorn and Janchar, and Veal and Hussey (207). The latter reporting 16 such cases. In all these however the involvement of the arm has been but an incident and frequently a terminal incident, in the illness of a patient obviously suffering from serious congestive cardiac failure.

**Mediastinal compression.** Several cases have been reported complicating an aneurysm of the ascending aorta (119, 197). Other patients have had positive Wassermann reactions but without evidence of an aneurysm (45, 64, 141, 181, 201, 222). In one such case Huard believed the condition to be secondary to a syphilitic mediastinitis, but 6 months later an aortic aneurysm was discovered. A mediastinal tumor is more likely to result in compression of the left innominate vein and cause hypertension in both the jugular and



subclavian distribution the superior vena cava itself may be involved. The history, and the clinical and roentgenographic examination render the diagnosis a comparatively easy matter in these cases.

**Axillary compression** Metastatic glands from a primary carcinoma of the breast sometimes cause swelling of the upper arm which may be due to pressure on the main venous trunks or to blockage of the lymphatic vessels. Lymph glandular enlargement from other causes rarely results in serious compression of the axillary vein. Aneurysm of the axillary artery (45) axillary hematoma (143) or scar tissue is an occasional cause of venous stasis, but such lesions are obvious on examination.

Swelling of the upper extremity without signs of venous stasis may occur in extensive cellulitis and lymphangitis. Severe injuries of the brachial plexus causing paralysis of the upper extremity may be accompanied by a temporary swelling of the arm. Cerebral monoplegia, syringomyelia, radiculitis, and hysterical edema have been mentioned, but none of these conditions can ever be a source of confusion in diagnosis.

Arteriovenous aneurysms may cause enlargement of the limb with dilatation of the superficial veins the diagnosis can be made from the history and by the presence of a tumor over which there is a thrill and a murmur. If need be, confirmation of the diagnosis is provided by further investigations, such as estimation of the venous content which is raised in this condition.

#### COURSE AND COMPLICATIONS

The acute symptoms of the syndrome subside after a comparatively short interval, varying from a few days to a few weeks. As the swelling decreases, the collateral circulation becomes more obvious. Complete recovery which implies not only functional recovery but also the disappearance of all pain swelling, and discoloration, and the return to normal of the superficial venous system, has been claimed by many, but a critical study of the cases, combined with a careful follow-up leads one to doubt whether this ever happens however the majority perhaps, ultimately enjoy freedom from symptoms.

So far as it is known, no death has occurred in any case of the Paget Schroetter syndrome. Moore (142) reported a fatal pulmonary embolism which originated from a thrombus in the axillary vein in a woman of 71 years, 4 days after she sustained a fracture of the humerus.

Tommasi patient was a man of 45 years who complained of a recent onset of swelling and

discoloration of the right arm. He had been ill at intervals for many years and only a month previously had suffered from an attack of pleurisy. His condition deteriorated and, as his arm was becoming progressively swollen, it was disarticulated at the shoulder. The patient died some days later and autopsy revealed an empyema, multiple thrombosis, pulmonary embolism, and necrosis of part of the arm.

Remijnse reported a somewhat similar happening in a patient of 60 years who died a few weeks after admittance to the hospital. Autopsy revealed thrombosis of most of the large veins, endocarditis, pneumonia and gangrene of the arm.

None of these cases resembled those under consideration and they therefore belong to a different category. So also do the cases with congestive cardiac failure reported by Veal (206) Emmelhorn and Janchar and others. Veal and Hussey (208) found such a high incidence of fatal pulmonary embolism in such cases that they suggested ligation of the subclavian vein.

**Nonfatal pulmonary embolism** This is of extraordinarily rare occurrence, if indeed it ever occurs. Despite the absence in most cases of any special treatment, embolism has been reported in only 3 patients. Schepelmann (190) removed a thrombus from his patient and 5 weeks later a pulmonary embolism is said to have occurred. It is of significance that the patient, a man of 32 years, suffered from mitral insufficiency and bradycardia, so that two abnormal factors were present—operative trauma and cardiac disease. Roelsen (178) treated 3 patients with heparin and one of the recipients, who previously had an exacerbation of phlebitis following a venogram, developed pulmonary signs believed to be due to infarction. Neff reported embolism in one case but gave no details.

**Involvement of the opposite arm.** This is also an unusual event, although 6 such cases (5%) have been reported, 2 by Kux (107) and 3 of the remainder by British authors. Firth and Mackay reported the case of a girl of 19 years who developed the condition in the right arm after stirring a pudding 19 months later the left arm became involved although there was no precipitating factor on this side. Selim recorded the case of a man of 36 years in whom the right arm was first affected and 6 weeks later swelling and discoloration appeared in the left. Bellios and Houghton reported the case of a man of 34 years who after a gradual onset in the right arm suddenly experienced swelling and discoloration of his left.



Fig 17 Venous obstruction of the left arm.

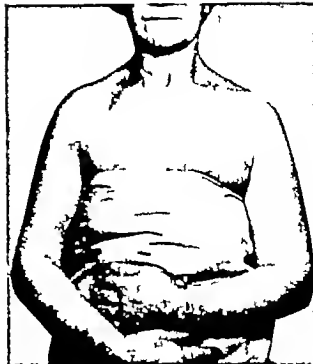


Fig 18. Same case as in Figure 17 Infra red venography

*Recurrence of symptoms* Matas gave an account of a man of 26 years who strained his right arm at work. The patient experienced pain followed by swelling of the arm the swelling subsided later but each time he returned to work the pain and swelling recurred and this happened over the whole period that the patient was observed (4 years). The same writer reported similar exacerbations in another patient observed for 12 years and many others have had the same experience (11 16 61 70 78 79, 84, 101 130 150 171 177 184 215). Veal (206) reported persistent recurrences in 3 patients followed for 6 10 and 22 years, respectively. Recurrences always follow exercise unlike the original attack and are to be attributed to inability of the venous collaterals to respond to the increased flow of blood through the arm rather than to further injury to a vein which has been incompletely occluded by the initial trauma.

*Persistence of symptoms* Swelling discoloration and obvious collateral veins are permanent to some degree. Slight swelling need cause no discomfort to the patient and is easily overlooked. Prominent collateral veins merely signify that the body's compensating mechanism has performed its task more or less efficiently. However pain and discomfort frequently persist and may partially disable the patient. It is possible to segregate arbitrarily only the recurrent symptoms from the persistent, for the former imply a collateral circulation sufficient for all but vigorous work, and the latter, a compensation that

is less efficient. This view is more rational than one visualizing varying degrees of absorption and recanalization of a thrombus (11 84, 159, 171) which has not been proved to exist in all cases.

Many cases have occurred in patients engaged in heavy employment, and as there is a tendency for the symptoms to persist or recur several protracted medicolegal arguments have followed, with the judgment usually in favor of the patient (79 131 150, 171 179) although in Ljunggren's case the etiological importance of trauma was successfully contested.

#### ETIOLOGY

The most common cause of venous obstruction in the lower extremity is a thrombus but it is doubtful whether such obstruction produces this condition in the upper extremity. It is true that in many of the cases subjected to operation a thrombus has been found in the axillary or subclavian veins. Schepelmann (190) Bazy and others have incised the venous wall and extracted clots, while some surgeons have excised part or the whole of a thrombosed segment. Some of these specimens removed at operation have been examined histologically. For example Roelsen (178) found the vein to be almost completely obliterated, with a narrow central lumen surrounded by granulation tissue containing phagocytes. Other sections showed more recent thrombosis. Lapeyre noted considerable intimal

proliferation, partial rupture of the venous wall, and an organizing thrombus.

Frequently however the surgeon has found no thrombus. In one of Roelsen's cases (177) the subclavian vein was explored but there was no sign of any thrombus a few months later the axillary vein was exposed and it likewise was perfectly normal. The symptoms and signs of venous stasis persisted after the operation. In another case of the same author an exploration of the axillary vein failed to reveal any thrombus although the vessel and its tributaries were dilated. In a third case the subclavian vein appeared quite normal and no thrombus was seen. The subclavian and axillary veins were explored in Ljunggren's case and there was no evidence of thrombus formation. Puhl had a similar experience he operated on 2 patients 25 months and 8 months, respectively after the onset, and found the walls thickened but no thrombosis. Hauge explored the third part of the subclavian vein through a subclavicular approach no thrombus could be felt and the venous walls were of normal appearance. Wolsten (220) found the axillary and brachial veins dilated but there was no intravascular clotting. Others have recorded similar experiences (39, 122, 125, 136, 143, 163).

In reviewing these findings one must be careful to remember that the extent of the exploration is often uncertain from the description of the operation. It is conceivable that a small thrombus was present in an inaccessible part of the vein. The problem is further complicated by such instances as that reported by Wolsten (220) in which palpation revealed a tender tumor in the axilla. It was believed to be a thrombosed vein, yet at operation the vein was normal. Roelsen (178) suggests that certain clinical differences exist between the thrombotic and nonthrombotic cases. In the former group he thinks that the precipitating trauma is negligible and that the patient frequently has a mild elevation of temperature. However there are many exceptions to this and such a partition appears to be wrong.

Whether thrombus formation be of primary or secondary importance its cause must be sought. Winterstein and Stover and Herrel both reported cases of polycythemia presenting with thrombosis of the axillary and subclavian veins the latter reviewed the literature and found that this was such a rare association that only one similar case had been reported (a patient of Parkes Weber). In no other case has a full examination of the blood, either chemical or cytological, revealed any predisposing cause whatever and this possibility may be dismissed.

A few authors believe that slowing of the blood stream is an important factor. Lowenstein and Schwindt considered that the presence of valves within the veins and fixation of the venous wall to the costocoracoid ligament, the clavicle and the rib, retarded the rate of blood flow. As pointed out previously cardiac failure may be complicated by axillary and subclavian thrombosis, and Ruge considered that such could be regarded as an early manifestation of circulatory failure. Humphry described such a complication in the terminal stage of a debilitating illness in a girl of 19 years and in a man of 45 who died of phthisis, the right upper extremity having for some days been oedematous, and the superficial veins of the arm and shoulder distended, we found the subclavian vein, near its junction with the internal jugular blocked up by a tough brown clot, which was adherent to the interior of the vein. Blumer described a similar case and reviewed several others from the literature. These cases are seemingly terminal events and differ fundamentally from those considered here in which the patients are healthy active people, in whom any general blood stream stasis may be at once excluded.

Most attention has centered around the possibility of an abnormal venous wall which acts as a focal point for thrombus formation and a few believe that infection is the cause. Wilson recalled the rarity with which phlebitis occurs in the upper extremity in typhoid fever but stressed the importance of syphilis. In support he quoted Marcel Gangard who reported 2 cases of subclavian thrombosis, and Muscher whose patient developed brachial thrombosis all 3 patients were syphilitic. Gould and Patey (70) Sloan and Roberts, Leocadio and Huard (88) have reported thrombosis of the upper extremity complicating an aneurysm of the aorta, while others have had patients with positive Wassermann reactions but without aneurysmal formation (45, 64, 141, 181, 201, 222). Paget and Lenche prescribed anti-syphilitic treatment in their cases although there was no evidence of the infection. Humphry was the first to report the condition in tuberculous patients. Aldrich collected 9 cases from the literature and added one case of his own. Other cases have since been described (217). This occasional association of specific infections with subclavian and axillary thrombosis provides no significant information on the etiology of the Paget-Schroetter syndrome.

The theory of nonspecific infection was advanced by and received considerable support from, French authors (2, 30, 97, 115, 118, 183).

Lecene considered that the alleged trauma was usually too trivial, while Lenormant (117) and Ducuing suggested that the role of injury was merely to activate a subclinical infection. In support of an infective origin is the unquestionable fact that some of the patients have fever, a few have displayed leucocytosis and the blood sedimentation rate may be elevated. Forster's patient and one of Sampson's (184) suffered from chronic sinusitis in addition to the axillary thrombosis; other cases also have followed an upper respiratory tract infection (43 67 72 95 106).

Several histological and bacteriological examinations have been cited as favorable evidence for infection. Huard and Lenormant (89) reported chronic inflammation of the walls of the vessels, most marked around the vasa vasorum. Chifoliau and Follason noted many leucocytes in the venous wall, and microscopic examination of the resected portion in Herbrand's case also suggested latent sepsis. In Lenormant and Mondor's specimen (118) it was said that it was actually possible to see staphylococci about the vasa vasorum. Patel and Morel Fabo resected 12 cm. of a thrombosed segment and histological examination revealed recent thrombosis with partial organization and moderate infiltration of the vessel wall with leucocytes, while staphylococci were obtained from a culture. Chifoliau and Follason cultured the staphylococcus, Grimaud and Dantlo the streptococcus viridans, and Lenormant and Mondor (118) obtained a very feeble growth of the staphylococcus albus and the colon bacillus. Broca reported that the axilla appeared inflamed at operation. Biehl found a lymph gland in such close connection with the venous walls that it had to be removed by sharp dissection, and examination of the gland later revealed a subacute non-specific inflammation. Both Biehl and Rosenthal believed that the close proximity of these glands to the axillary vein provided an easy opportunity for direct transmission of infection. Girard (66) and Wulsten (220) observed patients with septic hands, but with mild infection on the same side as the lesion.

However the evidence is against infection in any but the occasional case. Most of the patients show no systemic reaction at all: the temperature, pulse, white blood cell count, and sedimentation rate are normal. This disproportion between the local condition and constitutional disturbance is one of the remarkable features of the syndrome. Moreover specimens obtained at operation have on many occasions proved sterile. Axillary thrombosis is a rare condition; yet axillary adenitis secondary to infections of the hand is common.

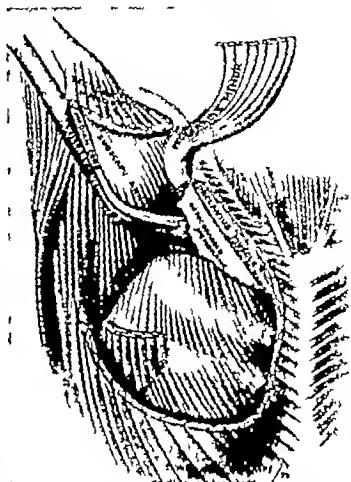


Fig. 19 Veal and McFetridge (209) believed the axillary vein was constricted against the subscapularis muscle with stretching of the vein just proximal to the point of constriction. (*Archives of Surgery*)

Most authors believe that trauma is responsible: the intima is damaged and a thrombus forms. Although the condition has followed a direct injury varying from a mild blow on the arm or shoulder to severe crush injuries of the chest (26 40 44, 81 101 107 126 154 155 158 171 218) it has much more often been induced indirectly. The onset has frequently occurred at the time of or soon after lifting a heavy weight (Table I). On the other hand, Stahns reported an example in a man working with his arms above his head installing an air plane motor. Lenormant and Mondor (118), a painter at work on a ceiling. Ffrench a patient who was in the habit of reaching for objects. Roelsen (178) a man who lifted rolls of cloth from shelves. Gould and Patey (70) a clerk who considered his swollen arm to be a sequel to the insertion of 18 screws into a wall above his head, and another case which was attributed to the placing of jars on a high shelf, and De Bakcy Ochsner and Smith believed one of their cases was caused by the patient's sawing a tree with his arm above his head. Hartmann

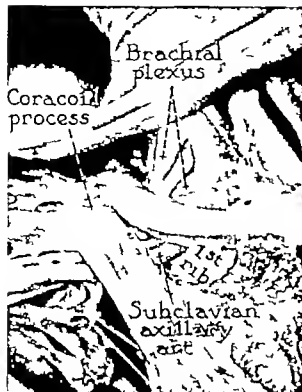


Fig. 20. Wright (119) considered that the vein was damaged as it passed posterior to the pectoralis minor muscle beneath the coracoid process. (*American Heart Journal*.)

described an onset which followed an extra strain to push a bed past an obstacle. McGoogan and Simmons and O'Regan, instances due to strenuous pulling efforts. It may follow such sustained movements as washing clothes (179-207) or dishes (184) swinging a sledge hammer (216) or a 25 pound book (171) pitching soya beans (132) or stirring a heavy pudding (61) digging a hole with a crow bar (86) beating time with a baton (43) prolonged carving (56) pushing and pulling heavy silk measuring machines (102) overtime in iron smith work (152) or bell ringing (162). It has been reported in tennis and squash players (33, 184, 201) golfers (70) baseball players (84, 101, 130, 184), rowers (200, 215) boxers (163) swimmers (3), basket ball players (158, 178) and those engaged in gymnastics (12, 36, 59, 98, 139, 149, 177). It has been noted in drunkards (33, 143, 215) and in epileptics (106, 216). It may follow as trivial an episode as putting an arm into an overcoat sleeve (128). There may be nothing at all to account for its onset, and no fewer than 39 persons (13% of the number in which the onset is described) awoke with symptoms of the disease (Table I).

Attempts have been made to analyze the movements of the upper extremity and to isolate some specific maneuver common to every case. For example Taylor believed adduction at the shoulder to be important. Veal and McFetridge (209) and Neij adduction and McGoogan and Simmons, abduction and external rotation. Some believe it is a minimal effort (64, 116) others that it is of undue vigor (39, 150).

Several anatomical investigations have been conducted with the object of locating a vulnerable site in the course of the axillary and subclavian veins, and as a result each part of these veins has been regarded, at sometime as the part at fault.

Veal and McFetridge (209) put forward the view based largely on venographic studies, that the axillary vein might be damaged by action of the head of the humerus through the subscapularis muscle. This theory has received little support (Fig. 19).

Wright believed the vein to undergo 'torsion, stretching, and pinching' as it passed posteriorly to the pectoralis minor and just beneath the coracoid process. The vessel is normally well protected, but in hyperabduction it is stretched around and beneath this process. By the same action the pectoralis minor is drawn tight, and it is suggested that this double action might injure the axillary vein (Fig. 20).

Willan considered the lesion to be in the first part of the axillary vein, that is, in the region between the outer border of the first rib and the medial edge of the pectoralis minor. He thought the vein somehow suffered damage against the rib border during vigorous exercise and that the intima of the vessel was roughened, which determined the onset of thrombosis.

Lowenstein concentrated his attention on that part of the vein lying between the rib and the clavicle. He pointed out that the inferior border of the costocoracoid ligament is sharp, strong and crescentic, and is strengthened by the tendinous fibers in the subclavius muscle. The inferior border of this muscle is fibrotendinous from its costal origin for at least 5 or 6 cm. laterally and fibrous bands may extend to the coracoid process. As the subclavius muscle and costocoracoid ligament follow the course of the clavicle laterally and posteriorly they cross the vein. When the arm is abducted to the level of the shoulder the subclavius muscle and costocoracoid membrane are put on the stretch and the sharp firm lower border of the costocoracoid ligament exerts considerable pressure on the superior surface of the vein. Lowenstein found that the maximum pressure was brought to bear when the arm was in extreme

abduction especially when rotated laterally the indentation, he thought, might be increased by the downward pull of the pectoralis minor. Gould and Patey (70) injected plaster of Paris into the axillary veins of postmortem subjects, the arms of which were held in fixed abduction. In one instance a shallow groove was obtained in the cast corresponding to the position of the costocoracoid ligament, while in 2 other cases a deep broad groove from pressure of the subclavius was seen. Lowenstein also noted that as the axillary vein crossed the shelving upper surface of the first rib it was provided with a valve. Gould and Patey (70) found this to be a fairly constant structure and suggested that its rupture a consequence of pressure was the fundamental pathological lesion. Hughes however found that with abduction of the arm the clavipectoral fascia which stretches between the costocoracoid ligament and the pectoralis minor pulled the former ligament away from the vein he was unable to detect any significant compression of the vein between the subclavius muscle (and the costocoracoid ligament) and the first rib.

Falconer and Weddell believed that the subclavian vein was compressed between the clavicle and the rib. They demonstrated that backward bracing of the shoulders sometimes led to distention of the superficial veins of the limb with opening up of the collateral venous channels across the pectoral region to the veins of the neck. The offending movements were, firstly and the more important, backward and downward bracing of the shoulders, and, secondly hyperextension of the neck, which probably also narrows the angle between the first rib and the clavicle. In this maneuver the scalene muscles may play the part of an elevator of the anterior end of the first rib (Fig. 21). Judovitch Bates, and Drayton favored this theory and referred to 2 cases in which the axillary vein was found to be dilated to one and a half times its normal size on the lateral side of the first rib. Others have also believed that in certain actions the clavicle compressed the subclavian vein against the rib (9, 200). However, Hughes did not support this view for he noted that as the clavicle approached the rib the subclavian vein slipped forward under the clavicle and away from the maximum pressure zone. Telford and Mottershead found that in normal subjects it was necessary to sever the intra-articular disc in order to approximate the rib and clavicle, although such compression might be important if the costoclavicular interval was already narrowed. In this connection it is of interest to note that cervical ribs are rarely found in cases of venous ob-

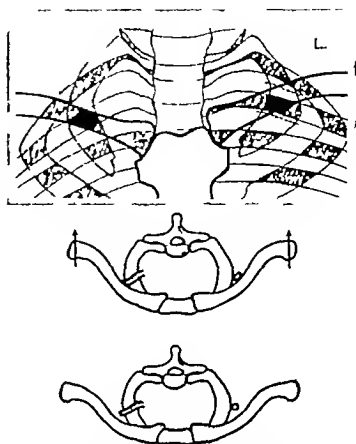


Fig. 31 Falconer and Weddell (54) thought that the vein might be compressed between the rib and clavicle (a) particularly in the presence of an abnormal first rib (b) (*Lancet* Lond.)

struction of the upper extremity although their presence has often been suspected. Hermodsson observed a patient with a cervical rib and Mc Googan and Simmons noted the suggestion of a cervical rib in their patient. In Pinelli's case the abnormality existed on both sides and was more prominent on the side of the venous stasis, while Andersson mentions a patient presenting a cervical rib syndrome with occasional swelling and signs of mild venous stasis in both arms.

Loehr (125) suggested that there was a 'relative' obstruction at the hiatus between the rib and the clavicle. Nearly all the blood from the upper extremity must pass through this narrow space in order to reach the caval circulation. Loehr considered heavy exercise caused a constriction at this point, which was aggravated by the increased thoracic pressure. The subclavian vein surrounded by strong fascia is prevented from overexpanding while the axillary vein which lies free is acutely overdistended a vein so damaged does not recover quickly but tends to remain dilated for several days and furthermore, it is more easily distended a second time and subsequently Loehr visualizes the resulting edema



the clavicle in one case and Clifton reported venous stasis of the upper limb due in part to an enlarged subclavius muscle and in part to a traumatic posterior subluxation of the clavicle. Rosenthal and Pellet (196 197) believed that unco-ordinated muscular action could detach venules from the main veins and so cause the intimal lesion necessary to initiate thrombosis. Lahaussous suggested that a sudden rise in the contraction pressure that the vessel wall was ruptured. Moure and Martin (143) at an operation performed 7 weeks after the onset found no thrombus, but the inner edge of the coracobrachialis muscle showed signs of considerable bruising and it was thought that a hematoma had compressed the vein. Cadenat and Veal (206) considered that forced expiration could in certain circumstances, damage the vessel. Pavlovsky suggested that the injury was sustained at the point where the subscapular and the circumflex humeral vessels drain into the axillary vein at this point the vein widens and presents a region of comparative spasm.

The role of spasm of the vessels in producing the clinical features of this condition is uncertain. There is some evidence that venospasm exists in many cases. Lapeyre and Cottalorda consider that venospasm provides the only reasonable explanation for the rapid onset and the rapid recovery that might occur. The latter believed the operative findings for vasomotor lesions and were caused by a focus of irritation in the plexus of tissues or actually within the lumen of the vessel it was an upset in the vasomotor equilibrium due to this focus which caused the edema rather than any obstruction of the vein. Based on these considerations Cottalorda and others have excised a portion of the vein or have performed a plexectomy or parietal sympathectomy. Instead of removal of this supposed focus of irritation or interruption of the sympathetic nerves by operative means, the assumed pathway of impulses may be blocked centrally by injecting the paravertebral sympathetic chain with novocain. This sympathetic block can have no influence over the venous obstruction if it is due to thrombosis. It may have a favorable effect on the peripheral circulation (147 207) but its chief value seems to result from the dilatation of the collateral vessels which it causes.

## TREATMENT

So few cases are seen in any one clinic that it is not surprising that there is no unanimity of opinion as to the most effective treatment. The



Fig 23 A prevascular phrenic nerve. The prevascular nerve occupies a more lateral position than the normal structure. It courses forward to cross the vein and then turns sharply backward to enter the mediastinum. It lies lateral to the external jugular vein. On inspiration the contraction of the scalenus anterior muscle and the elevation of the first rib increase the angulation of the nerve, while the descent of the diaphragm tightens the tendon of the scalenus anterior. (This specimen is now in the Hunterian Museum of the Royal College of Surgeons of England.)

problem is complicated by the variation in the course of the illness in the patients that receive no special treatment some making an apparently complete recovery in a short space of time, others having a protracted course and never regaining normal function of that limb.

No special treatment. In most cases treatment has been symptomatic without resort to any special measures. The patient is usually ordered to have active movements are indicated from the outset because it is thought that exercise promotes propagation of the lymphatics and veins, improves the circulation and discourages propagation of the thrombus there certainly appears to be no danger of dislodging a thrombus (178 207, 208) Heat



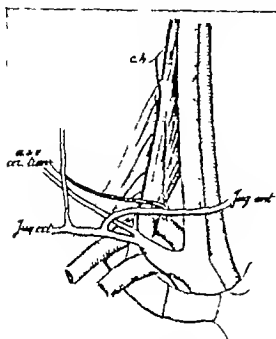


Fig. 14a

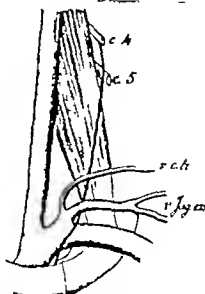


Fig. 14b

(101) ice packs (11), vasodilators (183) elastic bandages (104) and other ancillary measures have been used.

**Anticoagulants.** In recent years anticoagulants have been administered (6, 21 90, 98, 114 139, 178) but the cases are too few as yet to permit evaluation of such treatment. Theoretically these drugs should retard or prevent the propagation of a thrombus and so leave the patient a maximum number of tributaries which are all concerned in the establishment of a collateral circulation.

Heparin has an advantage over dicumarol in that the anticoagulant effect can be rapidly produced and rapidly stopped but the latter is less expensive and can be given orally. As dicumarol must be allowed at least 36 hours to produce its effect, it is the author's practice in similar circumstances to combine the drugs initially but to discontinue the administration of heparin after 36 hours.

Heparin (*Ikquemia*) is supplied in 5 c.c. vials containing 1,000 Toronto units per cubic centimeter. The contents of a vial are drawn into a syringe containing a little normal saline solution, and 5,000 units are given intravenously at 4-hour intervals for 36 hours.

Dicumarin (dicumarin-organon, dispensed in tablets of 50 mgm. each) is started by mouth on admission in a dose of 300 mgm. On the second

day it is reduced to 200 mgm. and subsequently a daily maintenance dose of from 50 to 100 mgm. is given with the object of keeping the prothrombin time between 20 and 30 per cent for from 10 to 14 days.

**Paravertebral cervical sympathetic block.** Ochsner and De Bakcy and Rieder were the first to recognize the value of injecting the stellate ganglion and the upper two or three thoracic ganglia with 1 per cent novocain in this condition, and the former subsequently reported 4 cases in which the patients were so treated. Others have also obtained good results. Bruce noted a dramatic improvement after a single injection in his case, but Ochsner and De Bakcy found that two or three injections may be necessary.

The author uses a posterior approach, with the patient either sitting and inclined forward, or lying prone. Three skin wheals are raised two and a half finger breadths lateral to the spinous processes of the seventh cervical and first and second thoracic vertebrae. A 10 cm. needle is inserted at right angles to the skin surface as far as the rib, under which it is maneuvered. It is inclined medially 25 degrees and pushed another 2 or 3 cm. From 5 to 10 c.c. of 1 per cent novocain are slowly injected at each point.

A sympathetic block should certainly be carried out before any other surgical procedure is contemplated.

**Operation** Uncertainty in the etiology and pathology is reflected in the uncertainty with which the surgeon has approached this problem. Considerable weight of opinion is against a surgical attack. An exploration of the axillary and subclavian veins is a formidable procedure and each vessel that is divided during the operation no matter how small it be is a handicap to the collateral circulation.

Attempts have been made to formulate indications for surgical intervention such as rapid increase in the swelling (14 39 88) persistence of swelling despite adequate rest (14 39 122 178) and recurrence on exercise (97). But in most cases the surgeon has been influenced by the belief that he might find and relieve an obstruction or eradicate or interrupt a focus of irritation.

**Phlebotomy and removal of clot** This has been performed on a few occasions (14 17 80 93 190). Whether a thrombus be secondary to an extravascular obstruction or an intimal lesion its removal, partial or complete will facilitate the establishment of the collateral circulation. How ever anticoagulant therapy commenced soon after the onset should obviate the need of such a procedure, while organization of the clot quickly renders chances of its success remote.

Schepelmann (190) was the first to report an operation in the treatment of this condition and he performed a phlebotomy with removal of the clots. Bazy reported rapid recovery of his patient following a similar procedure 9 days after the onset. Biehl and Henningsen were not able to extract all the clot from the veins of their patients.

**Exploration with or without venolysis** To dissect cover and remove an extravascular obstruction must be the main incentive to the surgeon. Yet the results of exploration have not been particularly encouraging. This is not surprising the axillary vein is not difficult to expose but the subclavian vein is relatively inaccessible indeed it is doubtful whether the first and second parts of the latter vein have ever been satisfactorily explored in this condition.

Ljunggren, Loehr and Puhl reported good results following exploration of the axillary vein and the removal of constricting bands of fascia. Wulsten (220) believed that the vein was compressed by a thickened Langer's arch which he removed. Zachau found the subclavian vein constricted at the level of the first rib and the patient improved after venolysis. Moure and Martin (143) operating 2 months after a recurrence found bruising of the inner border of the coracobrachialis muscle, and following evacuation of a serous exudate the patient was able to return to work in 3

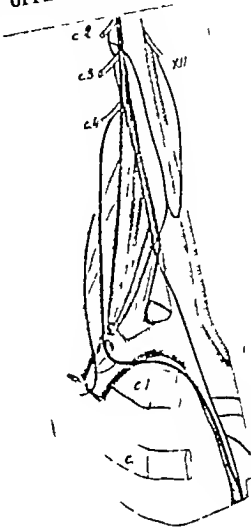


Fig. 24c

Fig. 24 Further examples of pre-venous phrenic nerves (Hovellacque, Monod, Eyraud and Beuzart (87)) (*Annales d'Anatomie Pathologique*.)

weeks. Zinninger found a thrombus within the axillary vein of Mont Reid's case and closed the wound without drainage following which the patient recovered rapidly (168). Fievez and Broca had similar experiences, but others have been less successful.

**Scalenotomy** Division of the scalenus anterior widens the costoclavicular interval and hence removes a possible extravascular obstruction. McLaughlin and Popma and Ney are the only authors to report such an operation and both obtained good results.

**Excision of a venous segment** This operation is designed to eradicate a focus of irritation which is said to exist in the vein or in the perivenous tissues and which is responsible for impulses exerting a baneful effect locally and more peripherally. Many satisfactory results have been attributed to this procedure, but equally as good progress has been made by those receiving no

TABLE L—REVIEW OF 320 CASES OF VENOUS OBSTRUCTION IN THE UPPER EXTREMITY

No	Author	Year	Sex	Age	Side	Cause	Onset	Initial symptoms	Chief symptoms	Treatment	Follow Up	Result
1	Paget	1871	M	30	R	No obvious cause	Gradual	Swelling	Heavy work	No special treatment	3 yrs	Recovery
2	Paget	1875	M	47	R	No obvious cause	Gradual	Swelling	Heavy work	No special treatment	—	Apparent recovery
3	Shewitzer	1884	M	44	R	Fracture and swelling	Sudden	Swelling	Discoloration	No special treatment	—	Functional recovery
4	Lachmann	—	M	—	R	Swelling tapered off after 48 hours	Gradual	Swelling	Discolored veins	No special treatment	3 mos	Functional recovery
5	Schroepman	91	M	—	L	Strained arm controlling blood pressure, then discolored and swelling	Gradual	Pain	Swelling distended vein	Operation phlebectomy and removal of clot	1 yr	Recovery
6	Huamcke	—	M	47	R	Milder as working	Sudden	Pain	Swelling	No special treatment	3 days	Recovery
7	Huamcke	94	M	40	R	Work as before, more	Sudden	Swelling	—	No special treatment	—	Recovery with mark
8	Huamcke	94	M	31	R	Left arm, weight	Sudden	Pain	Swelling	No special treatment	—	—
9	Ruge	1901	M	44	R	Swelling, no obvious cause	Sudden	Pain	Swelling discoloration	No special treatment	3 mos	Improved
10	Paget	—	M	—	L	Labored, no obvious cause	Gradual	Swelling	Swelling distended vein	No special treatment	3 yrs	Improved
11	Kawitzsch	93	M	—	R	Unavoidable, no obvious cause	Gradual	Pain	Swelling swelling distended vein	No special treatment	—	Disability
12	Kawitzsch	—	P	—	R	After playing with ball on every evening	Gradual	Swelling as	—	No special treatment	—	Recovery
13	Reem	—	P	44	R	Unavoidable effort lifting heavy weights	Gradual	Pain	Swelling discoloration distended vein	No special treatment	3 yrs	Partial disability
14	Brock	1913	P	5	R	Discomfort, arm during light work	Swelling	Pain	Swelling "phlegma"	Operation	7 yrs	Recovery
15	Dollers	1915	M	1	L	Arm during morning, no unusual movement	Sudden	Pain	Discoloration swelling W. R. +	Operation phlebectomy and removal of clot	—	Recovery
16	Gustave	—	M	49	R	No obvious cause	Gradual	Pain	Discoloration swelling W. R. +	No special treatment	week	Recovery
17	Langlet and Houdart	1915	M	—	R	No obvious cause	Gradual	Swelling	Discoloration swelling W. R. +	No special treatment	6 hrs	Improving
18	Moore	1915	M	40	R	Lifting pains	Sudden	Pain	Swelling	No special treatment	—	Recovery
19	Moore	1915	M	44	R	At machine heavy work	Sudden	Swelling	Swelling, hot area	No special treatment	3 days	Improving
20	Peble	1915	M	—	R	No obvious cause	Gradual	Swelling	Discolored veins W. R. +	No special treatment	—	Improving
21	Peble	1915	P	7	R	No obvious cause	Sudden	Swelling	Discolored veins discoloration "phlegma"	No special treatment	3 days	Recovery
22	Peble	1915	M	—	R	No obvious cause	Gradual	Swelling	Discoloration	No special treatment	—	Recovery
23	Peble	1915	M	—	R	No obvious cause	Gradual	Swelling	Discoloration	No special treatment	—	Recovery
24	Reichard	1915	M	24	R	No obvious cause	Sudden	Swelling	Discoloration	No special treatment	—	Functional recovery
25	Kawitzsch	—	M	—	L	Full 3 months previously full of blood	Sudden	Swelling	Swelling W. R. +	No special treatment	3 mos	Improving
26	Schroepman	—	M	—	R	Effort including very heavy work	Sudden	Pain	Discoloration swelling	Operation phlebectomy and removal of clot	—	Recovery

HUGHES	VENOUS OBSTRUCTION IN THE UPPER EXTREMITY	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	100
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TABLE L—REVIEW OF 320 CASES OF VENOUS OBSTRUCTION IN THE UPPER EXTREMITY—Continued

No.	Author	Year	Sex	Age	Side	Cause	Onset	Initial symptoms	Chief symptoms	Treatment	Follow Up	Result
30	Wunderlich	1915	F	33	R	Pain and heat right elbow	Gradual	Swelling	Pain, discoloration	No special treatment	—	—
31	Barry	1906	M	77	R	Venous work	Gradual	Swelling	—	Operation: Phlebectomy and removal of clot	mo	Recovery
34	Fredericks	1907	F	54	L	Metastatic carcinoma	Gradual	Discoloration	Distended veins swelling pain	No special treatment	3 mo	Improving
35	Fredericks	1907	M	33	R	Sporadic venous thrombosis	Gradual	Pain	Swelling distended veins	No special treatment	3 mo	Improving
36	Hartmann	1907	M	29	R	Painful hot, erythematous swelling elbow	Sudden	Pain	Hyperemia, "paralytic" swelling	No special treatment	3 mo	Recovery
37	Gold and Pezay	1908	M	54	L	Golf player	Gradual	Pain	Numbness swelling	No special treatment	3 yrs	Recovery
38	Gold and Pezay	1908	M	58	R	No obvious cause	Gradual	Pain	Swelling	No special treatment	mo	Partial recovery
39	Gold and Pezay	1908	M	54	R	Raynaud's disease	Sudden	Swelling	Discoloration pain	No special treatment	1 1/2 yrs	Partial disability
40	Gold and Pezay	1915	M	40	R	Thrombosing	—	Swelling	Weakness pain	No special treatment	7 yrs	Partial disability
41	Gold and Pezay	1915	M	54	R	Artery aneurysm in wall above hand	Gradual	Discoloration	Swelling numbness pain	No special treatment	3 yrs	Partial disability
42	Gold and Pezay	1915	M	48	R	Phlegm abscess on hand	Gradual	Distended veins	Swelling pain	No special treatment	3 mo	Partial recovery
43	Gold and Pezay	1915	M	47	R	Wrist fracture vein clamping collar	Sudden	Pain	Swelling	No special treatment	—	Partial disability
44	Gold and Pezay	1915	M	—	R	Heavy work increased circulation right hand	—	Pain	Swelling	No special treatment	6 mo	Partial recovery
45	Leitch	1915	M	58	R	No obvious cause	Gradual	Swelling	Pain	No special treatment	3 days	Recovery
46	Leitch	1915	F	37	L	Working clothes	Gradual	Swelling	Discoloration, distended veins pain	Operation: Lymph glands removed	mo	Recovery
47	Leitch	1915	F	33	R	No obvious cause	Gradual	Swelling	Distended veins discoloration	No special treatment	7 yrs	Partial disability
48	Leitch	1915	F	19	L	No obvious cause	Gradual	Swelling	Distended veins swelling	No special treatment	—	—
49	Leitch	1915	M	40	L	No obvious cause	Gradual	Swelling	Distended veins discoloration	No special treatment	3 wks	Recovery
50	Leitch	1915	M	19	R	Was lying on porch sunlight	Sudden	Pain	Swelling discoloration	No special treatment	—	Disability
51	Leitch	1915	M	58	L	Rapid femoral venous thrombosis previously no obvious cause	Gradual	Swelling	Distended veins	No special treatment	—	—
52	Leitch	1915	M	—	R	No obvious cause	A week	Swelling	Distended veins	No special treatment	—	Partial recovery
53	Leitch	1915	F	—	L	No obvious cause	A week	Swelling	Distended veins	No special treatment	—	Partial recovery
54	Thomson	1919	M	—	L	—	—	—	—	—	—	—



TABLE L—REVIEW OF 320 CASES OF VENOUS OBSTRUCTION IN THE UPPER EXTREMITY—Continued

No	Author	Year	Sex	Age	Side	Cause	Onset	Initial Symptom	Chief Symptom	Treatment	Follow Up	Result
106	Artemis	1913	M	22	R	Lifted sack of charcoal	Sudden	Pain	Swelling, discoloration	No special treatment	5 mo.	Improving
107	Chapman and Johnson	1913	M	46	R	Furunculitis at shoulder several days before	Gradual	Swelling	Pain, discoloration	Operation: Excision venous segment	3 mo.	Recovery
108	Cottalanda	1913	M	47	R	Lifted on legs weight	Sudden	Swelling	Pain	Operation: Excision venous segment and paravascular ligamentectomy	no	Recovery
109	Cottalanda	1913	M	47	R	Bronchitis, pneumonia	Sudden	Pain	Swelling	No special treatment	12 mo.	Disability
110	Fink and Jolley	1913	F	19	R	Swelling, hazy packing No obvious cause	Gradual	Pain	Swelling, discoloration	No special treatment	31 mo.	Partial recovery
111	Moore and Mayon	1913	M	—	R	Exhaustion the night before	Awkward	Swelling	Pain "paralytic"	Operation: Excision only	3 mo.	Recovery
112	Phelan	1913	M	46	R	Overtime work as iron smith	Gradual	Swelling	Discolored veins	No special treatment	—	Recovery
113	Phelan	1913	M	46	L	A bed-ringer	Gradual	Swelling	Pain, hemorrhage	No special treatment	—	—
114	Thomson	1913	F	27	L	Constrictive maid's petticoat	Gradual	Pain	Swelling, discoloration	No special treatment	—	Partial recovery
115	Fetis	1913	F	46	R	Ground for new people day previously	Awkward	Swelling	Discoloration	No special treatment	8 mo.	Recovery
116	Ward and Linsmead	1913	M	18	L	No obvious cause	Gradual	Swelling	—	Operation: Venous segment removed and paravascular ligamentectomy	—	Improved
117	Jones	1913	M	46	L	No obvious cause	Gradual	Swelling	Pain, distended veins	No special treatment	7 yrs.	Recovery
118	Lapierre	1913	M	31	R	Violent exercise	Gradual	Swelling	Discoloration	Operation: Excision venous segment	mo.	Apparent recovery
119	Lapierre	1913	M	—	R	Carried heavy pail of water	—	—	—	—	—	—
120	Leider	1913	M	3	R	Swelling	Gradual	Tightness	Discoloration, swelling	Operation: Excision and venotomy	mo.	Improving
121	Leider	1913	M	46	L	No obvious cause	Awkward	Swelling	Tightness, discoloration	Operation: Excision and venotomy	—	Recovery
122	Leider	1913	M	18	L	Accidental riding and driving horses	Gradual	Swelling	Discoloration, pain	Operation: Excision and venotomy	—	—
123	McGowan and Johnston	1913	F	43	L	Tearing of synovial ligament, laceration of foot	Sudden	Swelling	Pain, "paralytic" distended veins	No special treatment	7 yrs.	Partial disability
124	McIntosh	1913	M	—	L	Painful gonorrhea	Gradual	Swelling	Discoloration, distended veins	No special treatment	mo.	Recovery
125	Ross	1913	M	27	R	No obvious cause	Awkward	Swelling	Swelling, discoloration	No special treatment	—	Partial disability
126	Sherin	1913	M	46	R	Dark clothing No obvious cause	Sudden	Swelling	Distended veins, discoloration, pain	No special treatment	no info.	Recovery
127	Taylor	1913	M	18	L	No obvious cause	Awkward	Swelling	Discoloration	No special treatment	14 yrs.	Recovery

HUGHES VENOUS OBSTRUCTION IN THE UPPER EXTREMITY

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HUGHES VENOUS OBSTRUCTION IN THE UPPER EXTREMITY

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20 Abnormality of the circulating blood in section of the venous wall and general circulatory stasis are of no significance in the causation of this condition.

21 Injury to the vein resulting in thrombus formation on a roughened intima is the most popular conception. Each part of the axillary and subclavian veins has at some time, been incriminated.

22 An extravascular obstruction is believed by the author to be the probable cause, with thrombosis a common sequel. A pre-venous phrenic nerve may be the extravascular structure responsible.

23 Venospasm may play a role in the production of the clinical features, but it is difficult to attribute to it any etiological significance.

24 Anticoagulants should be administered as soon as possible after the onset. A paravertebral sympathetic block which assists the developing collateral circulation is advisable. If thrombus formation has already occurred operative success should not be anticipated if this complication has not resulted the collateral circulation should be adequate to compensate for the obstruction. Hence surgical interference is probably not justified.

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## SURGERY OF THE HEAD AND NECK

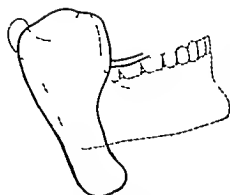


Fig. 3

Fig. 3. Superficial lobe of the parotid gland with a cervical extension.



Fig. 4

Fig. 4. Deep lobe variety A the "knob."



Fig. 5

Fig. 5. Deep lobe variety B the "rabbit warren."

## EYE

Research in Orthoptics. F. ELIZABETH JACKSON  
*Am J Ophth.*, 1948 31 805

The author points out that certain essentials are necessary to obtain a truer perspective of the whole field of binocular training and of the treatment of strabismus. In order to benefit from research in orthoptics the terminology used in orthoptics should be classified on the basis of ophthalmic technology. The evaluation of results should be standardized and sensory factors should be eliminated, and sensory variable factors should be collected and analyzed to stimulate data should be collected and analyzed to stimulate and direct further study of the etiology, manifestations and over-all treatment of strabismus. In addition, some knowledge of the basic principles of child psychology would be helpful so that a better understanding could be acquired of what can be expected of a child at various age levels.

Time and effort involved in research in orthoptics can be minimized by keeping records of the diagnosis, treatment and the follow-up data on all cases and by keeping an abstract file of current publications. The results of research in orthoptics can be given as a statistical survey a comparison study and individual case reports.

JOSHUA ZUCKERMAN M.D.  
Pathogenesis of Myopia: A New Classification  
1948, 39 273

The various theories of myopia are critically and historically reviewed in a comprehensive and scholarly manner. After careful consideration of the various theories, the author proposes a classification of myopia into (1) primary or physiological myopia and (2) secondary or pathologic myopia.

The concept of primary myopia is based upon the view that refractive errors are biologic variations and that people are hypermetropic or myopic by the same chance variations as people are short or tall. It includes myopia of both high and low degrees with the vision correctable to normal standards and the eye healthy.

Secondary myopia is a disease of the eye the cause of which has not been determined but which

process which it surrounds. The most formidable possibility is that in the depths of the warren the deep lobe is adherent to the jugular vein near its bulb. For this reason more than for any other the operator can consider that the exacting operation is virtually completed when he is convinced that the deep lobe consists entirely of normal parotid tissue. After the deep lobes including undoubted rabbit warrens *in situ* are left a salivary fistula following superficial lobectomy is often conspicuous by its absence.

The experience of the author in dissecting Stenon's duct in the living is at variance with what is depicted in works on anatomy. In over 80 per cent of the cases Stenon's duct is a rounded structure no larger than a fine hypodermic needle.

In a review of the results of parotidectomy by the author 45 of 54 patients were treated for tumors. In 17 cases the tumor was a recurrent one. In 1 case it had recurred 4 times, and a number of patients had received radiotherapy without benefit. As for the integrity of the seventh nerve in 2 patients no attempt was made to preserve it, because in one the nerve had been cut at a previous operation performed elsewhere, and in the other the anatomy was so extensive and fragile that the anatomy of the region was confused. Of the remaining patients over 40 per cent had temporary facial palsy lasting for varying periods up to a year. Only 5 of these showed signs of facial muscular weakness after a year but none of them were seriously inconvenienced. In all instances the integrity of the seventh parotidectomy that the integrity of the facial nerve cannot be guaranteed for several months.

Regarding the pure anatomy of the facial nerves as far as the author was able to ascertain Barry Anson, professor of anatomy, Northwestern University of Chicago stands alone among English speaking anatomists in teaching that the parotid gland is a bilobed structure with the facial nerve running between the lobes. The author supports this contention through his experience in the surgical treatment of the parotid gland.

JOHN E. KARABIN M.D.

# ABSTRACTS OF CURRENT LITERATURE

## SURGERY OF THE HEAD AND NECK

### HEAD

**Surgical Anatomy of the Parotid Gland** HAMILTON  
BAILY *Br J Surg* 1945, 245.

This is an excellent presentation on the surgical anatomy of the parotid gland with a review of the results obtained in 77 cases in which parotidectomy was performed. In 54 cases superficial lobectomy or total parotidectomy was performed and in the remainder extracapsular resection of a tumor was carried out.

There are considerable variations in the disposition of the facial nerve within the parotid gland, and for practical purposes it was stated that more often than not the facial nerve lies between a comparatively large superficial lobe and a variably sized deep lobe, the two being connected by an isthmus (see fig 1). It is on this anatomical concept that operations of superficial lobectomy and complete parotidectomy



Fig. 1. Diagrammatic conception of a coronal section through the parotid gland, showing the branches of the facial nerve sandwiched between the superficial and deep lobes.

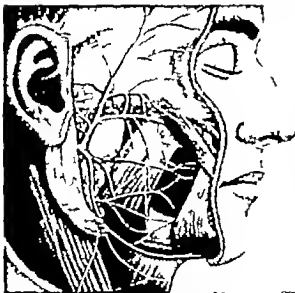


Fig. 2.

are rendered practical. Consequently a description of the surgical anatomy of the parotid gland is presented.

The facial nerve emerges from the base of the skull at the stylomastoid foramen. After a course of approximately 0.5 inch (1.25 cm.) it appears to plunge into the deep aspect of the gland a little below its middle. Actually it comes to lie in a groove on the under surface of the superficial lobe. For example the main trunk of the nerve can be separated by blunt dissection from the mobilized gland. The main nerve trunk approaches the parotid isthmus from behind, and on reaching the isthmus divides into an upper temporofacial branch which passes above the isthmus and a lower cervicofacial branch which passes below it (Fig. 3). Because of the relatively small size of the deep lobe, outlying subdivisions of the nerve—for instance the *pes anserinus*—rest between the superficial lobe and the masseter muscle. Particularly from a surgical point of view the temporofacial division which is often the larger of the two divisions, is the most important.

In a number of instances, after the two primary divisions of the nerve have embraced the isthmus they are connected at a varying distance in front of the isthmus by one or more anastomotic twigs (Fig. 3). No doubt this accounts for some cases of unexpected late recovery of partial facial paralysis following parotidectomy.

The isthmus is variable. Sometimes it is relatively broad even so the primary divisions of the facial nerve seem always to embrace it.

The superficial lobe also varies in size and shape. Large superficial lobes often extend as much as 2 inches (5 cm.) into the neck (Fig. 3). On scores of occasions in the course of excision of adherent tuberculous cervical nodes situated in the upper third of the neck it was necessary to resect a portion of the cervical prolongation of the parotid gland.

The deep lobe may belong to one of two categories, the "knob" and the "rabbit warren". In approximately 40 per cent of the cases with the knob type the deep lobe is relatively small, ovoid in shape and overlies the base of the condylar process (Fig. 4). It has been argued that if the tumor is removed satisfactorily by superficial lobectomy it is inconsistent with radical surgery to leave behind a piece of parotid gland (the deep lobe) even if this knob is presumed to contain normal tissue. However it is oftentimes uncertain whether the deep lobe is strictly of the knob variety. In the rabbit warren type of case there is a prolongation with the deep surface of the deep lobe that plunges behind the posterior border of the mandible (Fig. 5) toward the styloid

# SURGERY OF THE HEAD AND NECK

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same pressure movements may be observed in all arteries of visible organisms and there are no other movements performed by the arteries. The pressure movements in question are directly due to cardiac systole and diastole and arise as the result of periodical changes in arterial pressure. Notwithstanding that the arteries do not perform peristaltic movements they are because of their structure able to give an impetus to the onflow of simple mechanical laws. The arterial pressure movements are actually in the circulation on the basis of simple mechanical laws. The pulse therefore does not depend on arterial dilatation and contraction. The facts mentioned about arterial pressure movements together with the complete immobility of the present lead to the conviction of the pulse. A false pulse is met with in the artificial product caused by pressure theory on the cause of the pulse. The blood stream in its first phase originates at the genesis of life and continues to flow on uninterruptedly, receiving a rhythmic stimulus due to cardiac systole.

Summing up all of his results in brief the author states that the arterial pulse as well as the venous pulse is a passive pulse produced by a rhythmic throbbing due to eyeball pressure. The blood stream in the vein is uniform circulating without any oscillations because of pressure so that there is no difference between diastolic and systolic pressure. Because of a fundamental error of Bailliant's method pressure pulse has been identified with spontaneous pulse. A spontaneous pulse in the retinal artery comes nearer the truth. It can be observed in 80 per cent of quite healthy individuals who are not suffering from circulatory disturbances. The result turns out to be different in cases of rapid pulse. This depends on the rhythmic onflow thrust in the same way as the pulse due to cardiac systole in a section of the artery in other arteries. However only adequate experience in the observation of question of pressure in the afferent answer to the question of pressure in the afferent vascular system. Unfortunately such experience is humanly impossible.

The methods of investigating pressure in the brain on the eyeball creates entirely different circulatory conditions so that there is no analogy between these two methods. Considering that the difference between systolic and diastolic pressure is practically nil and is therefore not capable of being measured it follows that the spontaneous pulse in the retinal artery would necessarily be more distinct than at once and would necessarily be more distinct than the arterial pulse in which this proportion amounts to 0.6.

By Bailliant's method we are able to investigate the height of retinal venous pressure in so far as the vein does not present independent pulsation. It pulsates occurring already without pressure. Bailliant's

method does not enable us to estimate pressure in the central retinal artery but we can thereby determine the approximate pressure existing in the ophthalmic artery. In consideration that the central retinal artery is considerably narrower than the ophthalmic artery the pressure in it must necessarily be determined even lower which, however cannot be determined even approximately.

EARL H. MARR, M.D.

## EAR

Minimal Shock Pulse Trauma to the Cochlea—Acute and Chronic. H. B. FRIEDMAN, *Laryngoscope* 1946 55:466.

The author presents his views following a study of the literature on blast trauma to the middle and inner ear. Many reports are cited which indicate that damage to the inner ear as the result of industrial noises, gun shots and other battle noises, often with little or no evidence of injury to the middle ear may occur. His purpose was to perform experiments in which the cochlea was damaged by an explosive sound but no damage was done to the rabbit. The experimental animal used was the rabbit. The animal was exposed and perforated to provide a view of the middle ear structures and an ear speculum was inserted through the perforation through which by reflected light, the tensor tympani muscle was observed. The threshold for acoustic contraction of the tensor tympani was observed by presenting pure tones generated by a Western Electric 6 B audiometer through a loud speaker next to the eardrum. The intensity at each frequency needed to produce a just visible contraction of the tensor tympani when the tone was suddenly turned on and off was recorded. Average readings were taken as the threshold response for the ear. The opposite ear in all acute experiments was destroyed by entering the bulla and knocking off the promontory. In some chronic experiments both ears were used.

After establishing a threshold of a few tones was fired near the speculum in intervals of minutes to several hours. The shock pulse was developed by a .32 caliber blank cartridge fired from the starting pistol at a distance of 1 to 2 feet from the animal. A group of animals also, after exposure to the pistol shot, were allowed to live from periods of 3 to 12 weeks. After the experiments in fixing the bones were immediately sectioned serially and ultimately sectioned in the temporal bone.

In an analysis of the material obtained in these experiments the author found the following:

- 1 Small changes in auditory function in some animals as tested by little histologic evidence in the cochlea of the cochlea.
- 2 Profound loss of auditory function so tested seemed out of proportion with the limited histologic damage of the cochlea.



may be a chronic low grade choroiditis. It is associated with fundus lesions such as staphyloma, myopic crescent, choroidal atrophy degeneration and hemorrhage retinal atrophy and pathologic changes in the vitreous. The main factor in differential diagnosis of the two types is the appearance of the fundus. Proper classification is of great value clinically in therapy in prognosis and will prevent the waste of many useful citizens as "myopic cripples."

FRANK W. NEWELL, M.D.

**Ligament of Lockwood in Relation to Surgery of the Inferior Oblique and Inferior Rectus Muscles.** WALTER H. FINE. *Arch. Ophth. Chic.* 51:3 39-37.

The author presents an anatomical study of the suspensory ligament of the eye and its importance in the management of abnormalities of the inferior oblique and inferior rectus muscles.

Excellent reasons why surgery of the inferior oblique muscle should be done at its insertion rather than its origin are indicated. Fusion of the sheaths of the two muscles is very variable and surgery at origin is therefore also unreliable and variable.

In operating upon the insertion of the inferior oblique muscle the insertion of the muscle sheath is also of great importance and severance of the sheath is essential for good results. The recession and reattachment of the muscle should be in line of action of the muscle. The illustrations are clear and self explanatory.

EAST H. MEER, M.D.

**Effect of Roentgen Therapy on Experimental Ocular Vaccinia in Nonimmune and in Partially Immune Rabbits.** GEO. C. T. HARRIS, L. CHARLES H. REID, J. M. WELLS, LITTLE J. WYLLIE, J. BLANKIN, and OTHERS. *Arch. Ophth. Chic.* 51:3 39-53.

The effect of direct irradiation at different stages of ocular vaccinia in nonimmune and partially immune rabbits was investigated. Rabbit eyes were irradiated in 24 to 48 hours after inoculation with calf lymph virus at varying intervals after vesiculation commenced and at the height of the reaction.

Irradiation was of value as a means of hastening regression of the acute lesion and decreasing residual corneal opacities. This latter observation was not borne out by measurement of the transmission of light with a photoelectric technique. Additional animals were partially immunized by primary inoculation of the skin and 72 hours later the corneas were inoculated. At varying intervals thereafter the corneas were treated with roentgen therapy. Results were similar to those observed in nonimmune animals although in general, the disease was less severe and the residual opacities less. Partial immunity without irradiation also protected against residual corneal opacities.

The authors discuss the possible causes of the discrepancy between simple clinical observation of the cornea and the statistical comparison of objective measurements of light transmission with a photoelectric colorimeter.

FRANK W. NEWELL, M.D.

**Experimental Studies of Ocular Tuberculosis: Failure of Penicillin to Affect the Course of Experimental Ocular Tuberculosis.** JERRY D. KENNEDY, ALLAN C. WOODS, JOHN BUCKLEY MORGAN, BERTHOLD, and EARL L. BURKE. *Arch. Ophth. Chic.* 1943, 30: 361.

The anterior chambers of rabbits were inoculated with a culture of virulent human type of tubercle bacilli. Five weeks later animals with similar lesions were divided into treated and control groups. The treated rabbits received 50,000 units of penicillin G subcutaneously four times daily for 45 days. The course of the ocular tuberculosis was similar in the two groups and there was no clinical evidence of any inhibitory effect of the penicillin in the treated animals. The number of animals with visceral involvement was similar in both groups. Evaluation of the microscopic appearance of the eyes and viscera indicated less total ocular tuberculosis, less total ocular caseation, and less total ocular and visceral tuberculosis in the treated group; however the analysis indicated that these findings were not statistically significant.

It was concluded that the sample of penicillin G used had no therapeutic effect on ocular tuberculosis in nonimmune rabbits.

FRANK W. NEWELL, M.D.

**Norm 1 Optic Nerve: Classification of the Optic Disc Based on Branching of the Central Retinal Artery.** EVERETT H. WOOD. *Arch. Ophth. Chic.* 1943 30: 305.

The author presents a classification of optic nerve types based upon division of the optic nerve into quadrants, and observation of the distribution of the four main branches of the central retinal artery in the various quadrants.

In a study of 500 fundi, the most common type presented a distribution of both inferior branches in the nasal inferior quadrant with distribution of the two superior branches in the two superior quadrants (35.2%). The second most common type had a symmetrical distribution with branches in each quadrant (31.6%). The third most common type had the distribution of all vessels on the nasal side of the disc (16.6%). There were none of the type with all branches on the temporal one-half of the disc. Most of the individuals observed (53.4%) had dissimilar optic discs.

FRANK W. NEWELL, M.D.

**Observations on the Pulse and Retinal Arterial Pressure.** W. KAPROSCHEK. *Brit. J. Ophth.* 1943, 37: 373.

This article concerns the arterial movements in the central retina of the eye which are magnified four ten times and easily studied.

In the fundus oculi we observe, simultaneously with the pulse arterial movements depending on the impetus given by the local artery. These movements appear in two phases. The first phase due to cardiac systole, is rapid the second, due to diastole is slow. Any other movements, viz., arterial dilatation and contraction do not take place. The

# SURGERY OF THE NERVOUS SYSTEM

## BRAIN AND ITS COVERINGS CRANIAL NERVES

Actinomycosis. J ROBERT JACOBSON and RALPH B CLOWARD *J Am. Med. Ass.*, 1948, 137, 169.

The authors present a report of the first verified case of actinomycosis of the central nervous system with recovery. Prior to the advent of chemotherapy (1937) a review of the entire medical literature revealed some 108 cases of actinomycosis of the central nervous system. The disease was routinely fatal. After the advent of the sulfonamides and antibiotics several recoveries of systemic actinomycosis were reported. Recent literature has stressed the specific value of these drugs in actinomycotic infections.

A detailed case report is presented and the importance of the bacteriological examination is stressed. The average case shows thick pus in the spinal fluid with high cell counts predominantly poly morphonuclear leucocytes. Sugar is absent. The temperature range from 101 to 103 F. The patients do not appear as toxic as would be expected from the abnormal findings noted in the spinal fluid. There is usually paralysis of several cranial nerves. The white blood cell count ranges from 17 000 to 25 000. Sud den unexpected death in a patient who seems not too acutely ill is characteristic of the disease.

This particular patient received intensive treat ment with sulfadiazine penicillin and streptomycin. HOWARD H. LAWDER, M.D.

**Treatment of Thoracogenic Brain Abscess.** J B FENWICKER and T HOMER SELLERS. *Lancet* Lond 1948, 2, 92.

A review of 20 consecutive cases of thoracogenic brain abscess revealed that 7 patients recovered from the cerebral infection and 6 were still alive. These 20 cases were observed among 100 patients with brain abscess who were treated in the past 9 years at the Nuffield Department of Surgery, Oxford during the past 9 years. Thoracogenic abscess is usually discrete and in the main mass is often single and discrete and in only 4 of the 20 cases were there multiple abscesses scattered throughout the brain. Abscesses like metastatic tumors, appear to develop at the junction of gray and white matter and in only one case was there a deep seated lesion and this was in the optic thalamus.

Bacteriological findings included 10 different types of organisms and 2 that were generally considered suit able for the type of treatment which aims at radical removal in the chronic, encapsulated stage but the use of penicillin and sulfonamides has been of great aid in their successful treatment.

A detailed report of 6 cases is given and the method of treatment is described. Elimination of the chest sepsis or at any rate its control by minor surgical

and palliative measures should always be attempted so that the risk of cerebral infection is minimised. Radical surgical measures directed at the thoracic infection and its elimination should be taken. If the patient is very ill, a burr hole is made over the ab scess and aspiration is undertaken on occasion the critical period. Radical removal can usually be undertaken if the patient's condition permits. Arteriography has been employed as a localising agent, although in other cases ventriculography is necessary.

It is advised that if the abscess is aspirated or sucked out in the acute stage the resulting cavity should be treated with penicillin at the time and the dura and bone flap dusted with penicillin sulfamerazone powder. The bacteriology should be determined and its susceptibility to antibiotics should be determined at the earliest possible time. Closure without drain age is recommended. Treatment of the brain abscess should be undertaken before chest surgery, if possible. The advent of any cerebral symptoms in a patient suffering from pulmonary infection calls for immedi ate neurological investigation for the possibility of a developing brain abscess.

HOWARD A. BROWN M.D.

**Transorbital Lobotomy.** CHARLES H JONES and JAMES G SHAWCLOCK. *Neurosurg.* 1948, 47, 471.

A brief résumé is given with regard to prefrontal lobotomy and its further development in this coun try and abroad.

Transorbital lobotomy was introduced by Fiam bert in 1937. The technique as developed by Free man in this country is described. It includes two electrically produced convulsions and lobotomy is performed on one side during the coma following the second seizure. This is immediately followed by a third electric shock, and the other side is operated upon during the ensuing coma. The instrument consists of a pointed, circular shaft of steel 14 cm. long with an attached handle. It is calibrated 7 cm. from the tip.

The patient is placed upon his back during the state of coma, and the eyelids are elevated by the operator who then pierces the orbital conjunctiva near the posterior margin of the conjunctival sac. The instrument is held against the nose and a small and parallel to the bridge of the nose and the anterior cra nial fossa until the seventh centimeter mark approx imates the margin of the upper eyelid. After its posi tion is carefully checked a lateral photograph is taken with the instrument in place. At this point the instrument is firmly fixed in the superior orbital plate and usually will not move if the operator's hand is taken away. However the fixation is easily overcome as the lateral and medial movements are made.

3. It was evident to the author that definite end organ damage and profound functional loss could be produced by shock pulses that did no visible damage to the middle ear structures.

4. In the animals showing a partial functional loss of the tensor tympani response, no uniform predilection for the high frequencies was noted.

5. Two functional reactions were observed: (a) evidence of recovery within several hours after exposure; (b) a rather rapid progressive obliteration of function within a few minutes after the immediate postblast threshold was taken.

6. No clear-cut relation was seen between the partial loss of function and the position of damage in the cochlea.

JOHN J. BALLENGER, M.D.

### PHARYNX

*Neuron Arcs of Clinical Significance in Laryngology*  
A. C. FURSTENBERG AND ELIZABETH CROSS, A.  
*Otol. Rhinol.* 1948 57: 295.

Specifically, the text treats of certain respiratory reflexes and the neuron pathways along which they travel. An attempt is made to describe various nerve circuits composed of peripheral nuclear and associated routes and to explain by reason of their position, relationships and function, some of the phenomena observed in clinical practice.

While much of this subject may be of only academic interest, it is nevertheless axiomatic that the basic sciences form the foundation of medicine. From a knowledge of them one may travel in any direction. A veritable panorama of opportunity is exposed to the individual whose interest is grounded in the fundamental principles of some phase of science, the opportunity for intelligent observation, research, the development of therapeutic facts and the ability to put these facts into discriminate practical usage. It may not be too much to expect, therefore, that this anatomical study of some of the reflexes of respiration may serve as a common core about which a better understanding of respiratory symptoms and a greater knowledge of rational methods of treatment may be developed.

Among the respiratory reflexes of clinical importance are hiccough, coughing, and sneezing. The author believes that the symptom of coughing is more often than not an expression of some strong feeling or impulse of a psychogenic nature.

The absence of pathologic changes about the brain stem in individuals who had died of meningitis gave rise to doubt that direct stimulation of the vagus nerves and later paralysis of them were responsible for the respective slowing and acceleration of respiration. The inquiry into a more rational explanation for these changes arose particularly from autopsy findings in cases of meningitis secondary to

nasal accessory sinus disease in which the craniate was largely confined to the surfaces of the brain.

While the text probes only superficially into the emotional factors responsible for respiratory variations such as hiccough, sneezing, and coughing, it deals specifically with the central nervous apparatus along which emotional impulses are carried. A knowledge of these pathways and a better understanding of parent-child relationships may widen our knowledge of the psychology of cough and asthma.

In discussion of the reflex arc of sneezing an effort is made to offer an explanation on an organic basis for the occasional complaint of nasal obstruction after a submucous resection of the septum in a patient who has wide open nasal cavities.

Finally this initial inquiry into the nervous mechanism of respiration and its common variations leads one to the conviction that much more work needs to be done if we are to achieve a thorough survey of this subject. The one generalization that may be derived from this discussion is that the whole mechanism of respiration is a complicated one governed by a reflex arc and an equally important central nervous system component susceptible to emotional stimulation.

There are 4 drawings of the various nerve circuits described in the text.

JOHN F. DILLON, M.D.

*Tonsillectomy Polymyositis Survey—1917* D. WIM.  
S. COWEN. *Laryngoscope* 1948 58: 503.

In an attempt to elucidate the relationship between recent tonsillectomy and the contraction of polymyositis the author reports the statistical results of questionnaires which traced 43 per cent of the cases of polymyositis reported throughout the country in 1947. The report is contrasted with a similar one previously published, which gave analyses of 53 per cent of the cases reported in 1946.

The 1946 survey showed that in 2.5 per cent of all cases of polymyositis followed the disease was preceded by a tonsillectomy while in 1947 the figure was 0.5 per cent. In 1946 1.1 per cent of the cases of polymyositis were preceded by various operations other than tonsillectomy, whereas in 1947, 1.9 per cent of cases were preceded by other operations—about 4 times as many as were preceded by tonsillectomy.

In addition to the surveying of the cases of polymyositis, 5,439 tonsillectomies performed in 15 different states in 1947 were followed for a period of 3 months post-operatively. Among this total, 2 cases of polymyositis were discovered.

In conclusion the author states that he is more convinced than ever that there is no causal relationship between recent tonsillectomy and the development of polymyositis, and that when a bulbar polymyositis follows a tonsillectomy it is purely coincidental.

JOHN J. BALLENGER, M.D.

CHEST WALL AND BREAST  
Menopausal Breast  
1948, 197

CHEST WALL  
 symptoms of the Premenopausal Breast  
 M. WAGGONER. Ann. Surg. 1943, 117, 1250  
 The effect of ovarian function on the production  
 of carcinoma of the breast has long been studied ex-  
 perimentally and in human beings. The palliation  
 in breast malignancy after oophorectomy has also  
 been shown. Widespread administration of estro-  
 gens however has been followed by relatively few  
 breast cancers and these have been thought to be  
 coincidental. The author reports the case of a 44  
 year old woman with extensive carcinoma of both  
 breasts and widespread metastases who six months  
 previously (at which time the breasts were said to  
 have been normal) was started on a course of theelin  
 therapy for menstrual irregularities which at first  
 had caused painful swelling of both breasts. The  
 patient was considered to be in the terminal stage  
 when seen but she began to improve and lived 19  
 months before succumbing to overwhelming metas-  
 tases. At autopsy replacement of ovarian tissue by  
 including complete replacement of the patient's clinical im-  
 tumor. It is suggested that the loss of ovarian substance  
 occurring with peritoneal spread of the tumor  
 Thirty nine additional cases of women under 50  
 years of age with breast malignancy are reviewed  
 with regard to abnormal endocrine patterns as re-  
 flected in menstrual evidence of hormonal imbalance  
 presented clinical evidence of hormonal imbalance  
 Specific factors remain unknown but the relation-  
 ship of ovarian hormones to breast malignancy is  
 suggested by these cases  
 JESSIE E. THOMPSON, M.D.  
 GCS. AND PLEURA  
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TRACHEA, LUNGS, AND PLEURA

There is a small progressive increase in the volume of the tracheobronchial tree from the larynx to the bronchi measuring 15 mm in diameter. It is from 50 to 100 per cent. In this portion of the tree there does not seem to be any very effective air cleansing device except the direct impingement of the air on the mucous blanket lining the tree. There appears to be a very considerable expansion in the volume of the tract in tubes of less than 15 mm. in diameter. Before the cilia cease the tree has divided into bronchioles which number somewhere between 15,000 and 70,000 each of which is lined with ciliated epithelium and a sticky mucous blanket. The total circumference of these tubes measures many meters. This "bronchiolar filter" is an effective final device to protect the alveoli from dust and fumes which may gain

SAMUEL KAHN M D

From the upper lobe the principal branches are of two classes (1) the deep tributaries which are referred to as apicoventral, apical and ventro-axillary, and (2) the superficial tributaries which are called either mediastinal or fissural

Very little resistance is felt to the passage of the narrow shaft as it is moved through the brain. A movement of 15 degrees medially and laterally severs the connections in the subcortical white matter and displaces the cortical arteries without lacerating them. A greater sweep of the instrument is unnecessary and may be dangerous. On being brought back to the midline of the orbit, the instrument is carefully withdrawn. With the withdrawal of the instrument a gauze pad soaked in a saturated solution of boric acid is applied over the eye with firm pressure to minimize hemorrhage in the orbital tissues.

No preparation of the operative site is necessary as the instrument is introduced into a sterile field—the conjunctival sac.

Forty-one patients whose cases are reported in this series were subjected to this type of operative procedure. There were 26 cases of schizophrenia, 6 cases of manic depressive psychosis, 3 cases of agitated depression, 2 of so-called mixed type psychoneurosis, 3 of obsessive compulsive neurosis, 1 case of ritualistic melancholia, and 1 case of intractable pain of the thalamic syndrome. Twenty-six of the patients were women and 15 were men. The oldest patient was 67 years of age and the youngest was 18 years.

The results were classified as "good," "fair," and "poor." A good result is one in which the patient has the capacity to adjust outside the hospital with little or no supervision. A fair result implies that the patient can get along on a parole status with moderate supervision or that there has been a striking improvement in his behavior to a point where only little hospital supervision is required. Although the patient may show improvement in many ways the result is regarded as poor if considerable hospital supervision is necessary.

Thirty-five patients whose postoperative period was longer than 1 month were graded on the above basis: 16 received a good result, 12 a fair result and 7 a poor result.

The immediate postoperative course is said to differ sharply from that of prefrontal lobotomy and the patient is ambulatory as soon as the effect of electroshock anesthesia subsides. He may present one or two black eyes as the only physical evidence of having undergone surgery. No deaths were reported.

A unilateral ptosis of the upper eyelid was produced in 4 cases but gradually disappeared.

HOWARD A. BROWN, M.D.

#### PERIPIERIAL NERVES

Lacerative Lesions of the Brachial Plexus (Le lésion da strappo del plesso brachiale). LEONARDO GUERCHI *et al.* *Chir. org. mod.*, 1948, 31: 97.

Eight cases of paralysis of the brachial plexus from the Putti Institute of Bologna, Italy, form the basis of this report. All of the patients were soldiers. In 5 cases the injuries were due to motorcycle traffic acci-

dents; in 1 case the injury occurred as the result of a falling beam during bombardment; in 1 as the result of a fall from a horse; and in 1 as the result of a railroad accident.

In all of the injured the plexus was exposed upward to the point of issuance of the nerve roots from the intervertebral foramina and downward into the axilla. If indicated, through an incision from the upper end of the sternocleidomastoid muscle across the clavicle and then downward and outward onto the chest. The clavicle was cut through and, if necessary for exposure or nerve suture, a section of this bone was resected together with the subclavicular muscle.

In 2 cases the symptomatology indicated the interruption of the fifth and sixth cervical roots; in 5 cases the syndrome was that of total interruption of the plexus and in the remaining case the condition was diagnosed as a dissociative paralysis of the lateral and posterior fasciculi.

Of the 2 cases of upper root disturbance, no interruption of the nerves was found at operation; in one here a simple nerve lysis was done and the motor function of the muscles returned to normal; some sensory disturbance remained. In the other patient there was a covered interruption of the fifth root and a laceration of the sixth spinal nerve root from the axilla. Here the peripheral stumps of these nerves

reunited by nerve suture to the fifth root and the patient recovered active contractions in the bicipital, pectoral and long supinator muscles.

In the instance of dissociative paralysis also, the peripheral trunks (axillary and radial nerves) could be reunited to their corresponding posterior fasciculus and the interrupted part of the lateral fasciculus could be reunited *in situ*. This patient regained active contraction of the deltoid and biceps muscles. In one case in which suture was possible all three fasciculi were reunited to their proximal stumps; here, however, the operation has been too recent for evaluation.

In the remaining 4 cases, a careful and extensive nerve lysis was all that could be attempted; however, in 3 of these the pains were largely or completely relieved. In the fourth patient, it is believed that the source of the pain was an irritative condition in the spinal cord itself, resulting from the injury suffered in avulsion of the nerve roots, and that only a chordotomy would bring alleviation.

The author reports no experience in implanting the peripheral stump of the interrupted nerve into an intact root and he does not subscribe to the suggested periarterial sympathectomy for the relief of pain in these cases, since he thinks that neurolysis will accomplish all that can be done. Early operation is favored, and excellent results are reported for the combining of intramuscular injections of evipan (8 to 10 c.c.) with general ether anesthesia, and for the use of an aspirator and the electrocoagulator during the operation in these highly vascular tissues.

JOHN W. BREDENY, M.D.

# SURGERY OF THE THORAX

patient developed an empyema with a fistula in the operative scar. The fever subsided after insufflations of streptomycin and general improvement followed because of lack of the antibiotic, the empyema recurred and the patient died.

The third case was that of a patient 26 years old in good physical condition and aphyretic. He had a large paramediastinal cavity of the inferior left lobe circumscribed by interlobar and parietal adhesions. Bronchoscopy revealed slight inflammation of the mucosa of the left superior bronchus with minimal mucous secretions which suggested a good prognosis. The operation was uneventful and the patient is at present in good physical condition and aphyretic.

The authors conclude that (1) bronchoscopic examinations preceding lobectomy for tuberculosis enable the surgeon to decide the feasibility of surgical intervention (2) operability depends upon the condition of the tracheobronchial routes (3) specific infiltration of the respiratory pathways involving the lobar bronchus to be removed must be treated conservatively because of the possibility of spread of the infection.

The authors describe their method of bronchoscopy in the tuberculous patient and advise its use before lobectomy is performed.

JOSEPH M. A. PARE, M.D.

**Pulmonary Abscesses Attended with Pleural Complications.** JAMES L. HANSEN. *Ada chir scand* 1948, 96: 493.

The writer reports a material comprising 100 cases of pulmonary abscess of which 32 were associated with pleural complications. The incidence of pleural complications is the same in the presence and absence of pyopneumothorax. They are most common in connection with abscesses of the lower lobes. Definite rupture of abscess was found in 23 of 25 cases. Putrid effusion was found in 23 cases, 17 of which exhibited nonhemolytic streptococci. In a large number of cases there will be complete incongruence between the bacterial findings in the sputum and those of the pleural effusion even if there is a definite perforation of abscess. As a rule the pleural complications set in when the disease has persisted for from 1 to 3 weeks.

The treatment has primarily been directed against the pleural complications which has quickly been subjected to treatment with a rule. In 8 cases (a closed method) and suction drainage. In 8 cases pneumotomy was performed at the same time for pleural drainage. Secondary operation was required in 8 cases.

Eight patients died in the department, 4 after discharge. One of the patients still has a small bronchial fistula but the others (10) are well. The follow-up period ranges from 1 to 3 years. The prognosis is serious in patients already affected with a chronic disease of the lungs. It was chiefly such patients who died. Otherwise pleural complications of pulmonary

abscesses usually run a benign course with adequate drainage.

**The Treatment of Bronchiectasis (Tratamiento de las bronquiectasias)** OSCAR J. CAMER. *An. chir* Rosario 1947, 15: 335.

The author presents a general survey of the treatment of bronchiectasis. He points out the limitations of medical management and emphasizes the dismal outlook for untreated bronchiectasis. The justification for pulmonary resection in extrapating the bronchiectatic segments of lung is presented, as well as a consideration of the problems involved in bilateral bronchiectasis.

Brief reference is made to a personal series of 17 cases with 2 deaths. The bulk of the discussion however is based on material collected from author and other sources.

HIRSH T. LARGASTON, M.D.

**The Drawbacks Encountered in the Local Treatment of Pleural Empyema with Chemotherapeutic and Antibiotic Agents.** JAMES L. HANSEN. *Ada chir scand*, 1948, 96: 500.

In the local treatment of empyema, early and frequent punctures, aspiration of the pus, and intrapleural injection of chemotherapeutic and antibiotic agents in large doses are of great value during the first stage of the disease. In nontuberculous cases this treatment should, however, be replaced by permanent drainage and a fully expanded lung on the clear thoracic field and is obtained quickly. It depends to a great extent on the care and thoroughness with which the treatment is carried out as to how long a puncture treatment is sufficient and which patients require insertion of a drain. There is hardly any doubt that a few specially trained and enthusiastic therapists are capable of curing many patients with empyema by this form of therapy. Moreover, it is exacting and during the later stages of empyema is far more difficult than drainage. Moreover, it entails a fact that during the later stages of empyema permanent drainage affords the best chances of cure. One runs a greater risk in leaving even sterile pus and fibrin in the pleural cavity than in establishing drainage. As a rule, be put off to a time when it is practically impossible of the mixed infection. In tuberculous empyemas of the course of punctures and injections.

JOSEPH J. MALONEY, M.D.

**Intrapleural Penicillin in the Treatment of Acute Nontuberculous Empyemas Thoracis (La penicilina intrapleural en el tratamiento del empiema agudo no tuberculoso)** R. VALDIVIAO, G. SERRIVIERA, and R. RAMIREZ. *Rev. med. Chile* 1948, 76: 185.

The present report covers the authors' experience with 30 cases of acute nontuberculous empyema in

The lymph nodes at the hilum are divided into groups (1) the superior group, located just below the azygos arch (2) the middle group located between the main pulmonary artery and its chief branch to the upper lobe and (3) the inferior group located in front of the hilar portion of the lobar vein. The chief group of lymph nodes is the middle group, the inferior group is present in only 20 per cent of cases.

The treatise is illustrated by 9 three-colored plates and is accompanied by schematic drawings that are well labelled.

Practical points of application to the surgical removal of the right upper lobe are made. Twenty seven bibliographical references are added.

HIRSH T. LANGSTON, M.D.

**Hernia of the Lung (Hernia de pulmón)** ALFONSO J. FAYLOVSKY and VICENTE LAVENIA. *Bol Acad Argent Cir* 945, 32 29.

Herniation of the lung is a rather rare condition even though references to it have been made by ancient writers.

Its occurrence implies a forceful increase in intra-pulmonary pressure (such as may occur during coughing, defecation, vomiting or sudden effort against a closed glottis) impinging on a defect in the chest wall. This locus minoris resistentiae may be the result of trauma and local muscular atrophy or of congenital malformation. It occurs most often in the anterolateral portion of the chest wall. The character of the swelling and its increased size during forced expiration should suggest the diagnosis of hernia. The roentgenogram can usually be depended upon to demonstrate the exact nature of the lesion when taken tangentially to the chest wall.

The authors believe that hernia of the lung should be treated surgically and that other forms of palliative management such as the use of trusses are unsatisfactory. Their method of repair consists essentially in mobilization of the sac and its careful closure. This portion of the procedure implies an open pneumothorax and endotracheal anesthesia is recommended. The chest wall defect is closed by suture, reinforced by suturing an osteopericosteal flap obtained from the rib above the defect to a pericosteal flap obtained from the rib below the defect and imbricating them over the bursal ring. The superficial tissues are carefully closed over this in anatomical fashion with overall pressure dressings.

A case of lung hernia is reported in a 38 year old laborer whose acute symptoms were brought on by heavy lifting. The hernia occurred at the site of a stab wound incurred 17 months previously. This method of repair was satisfactorily employed.

HIRSH T. LANGSTON, M.D.

**Experiences in the Surgical Treatment of Pulmonary Stenosis.** JOHN R. PAINK and RICHARD L. VARGO. *Surgery*, 948, 24 355.

The authors review their series of 43 patients between the ages of 15 and 24 years, on whom they

performed the Blalock-Taussig operation for the relief of pulmonary stenosis.

The most common type of shunt made was an end-to-side anastomosis of the subclavian artery to the pulmonary artery (35 cases). In 5 cases an end-to-side anastomosis of the innominate artery to the pulmonary artery was done and in 3 cases an end-to-end anastomosis of a subclavian artery to a branch of the pulmonary artery was done. In 5 cases only exploration of the mediastinum was done. In the recovered patients almost uniformly good results presenting increased physical endurance were observed; there were also increased oxygen saturation of the blood at the average of 15 per cent and a correlated decrease in polycythemia and cyanosis.

Nearly all of the patients showed postoperative pleural fusion which in 8 instances necessitated aspiration because of dyspnea. Also there was noted an increase in the size of the heart after operation which was thought to be indicative of mild cardiac decompensation.

In 3 patients diffuse brain damage due presumably to inadequate oxygenation was noted. Two of these patients never regained consciousness. Three patients also died of cardiac standstill in spite of the injection of 1 per cent novocain into the vagus nerve and around the hilus of the lung.

The authors emphasize that these patients are best handled by a team consisting of a pediatrician, a roentgenologist, an anesthetist and two surgeons.

In view of the technical difficulties of an anastomosis on the right side the authors believe that in cases in which the preoperative oxygen saturation is over 50 per cent and only a small shunt is needed, an approach on the left side utilizing the subclavian with the pulmonary artery is preferred to the formation of an innominate-pulmonary artery shunt which has an appreciably higher mortality.

The authors elaborate on the technique and the anesthesia used, and also the psychometric observations before and after operation.

JAMES C. MACMILLAN, M.D.

**Preoperative Bronchoscopy in Lobectomy for Tuberculosis (La broncoscopia preoperatoria nella lobectomia per tubercolosi)** M. ARSLA and A. SC. *Riv. Minerva med* T. 945, 37 345.

The authors suggest preoperative bronchoscopic study of the tracheobronchial tree in tuberculous patients in whom lobectomy is contemplated, and present a report of 3 cases in which such a study was very helpful.

In the first case the bronchoscopic study revealed a large rigid cavity which contraindicated surgery.

The second case was that of a patient 32 years old, in good physical condition, apyretic, and with a large cavity in the right superior lobe of the lung. Bronchoscopic examination revealed the bronchus to be fibrosclerotic and stenosed up to its bifurcation, which necessitated a reserved prognosis. The operation though technically difficult, was successful however on the twentieth postoperative day the

## SURGERY OF THE THORAX

vascularity. Usually the structure or structures which must be treated surgically are either the ductus arteriosus or some structure which lies in the same side of the body as the ductus therefore it is advantageous for the surgeon to know, preoperatively on which side the ductus arteriosus lies in order that he may perform the thoracotomy on that side. Since the roentgenologist is not able to visualize the ductus arteriosus directly he must rely on indirect evidence in predicting its situation. The following rule although not infallible will be helpful. The ductus arteriosus usually lies on the same side of the thorax as does the upper portion of the descending aorta. By visualizing the site of the latter structure the roentgenologist may predict with reasonable accuracy the situation of the ductus arteriosus and guide the surgeon as to the proper side on which to perform the thoracotomy.

### ESOPHAGUS AND MEDIASTINUM

Combined Left Abdominal and Right Thoracic Approach to Resection of Esophageal Neoplasms. JOSEPH E. BLACKMAN. *Surgery* 1948 44 9

Progress in surgical therapy of neoplasms of the esophagus may be attributed to several factors: improved anesthesia, more adequate preparation and proved antibiotic therapy, more adequate blood replacement and increased knowledge of thoracic surgery.

The author mentions a few disadvantages to the left trans thoracic and thoracoabdominal approaches. The patient may be subjected to a major procedure in the thorax, only to find that the lesion has involved the liver. Also there is a tendency to compromise the amount of tissue resected on the proximal side of the neoplasm and cardiac reflexes. In the results from pulmonary involvement the procedure middle third lesions and azygos vein makes the procedure distal pleura and from the left side. Crushing of the more hazardous results in difficulty with the development of fluid in this area favors the development of pleuritis and diminishes tissue power. In developing his technique the author made two collections of intestals and later performed the procedure on 8 patients. He believes that a can cadaver dissections were adequate as a can procedure on 8 patients. He believes that a can procedure on 8 patients. He believes that a can procedure on 8 patients.

was technically less tedious than phrenic nerve mobilization. In the dissection proximal to the lesion the incision in the diaphragm encountered at the proximal excision of tissue proximal to the original procedure was less traumatic and consumed less time. The author states that this is not an original procedure since Ivor Lewis had already reported its use. The operative procedure consists of two stages. In the first stage the abdomen is opened to the left of the midline and dissection is continued by division of the left gastroepiploic artery and the vasa brevia. The left gastric artery is divided close to its origin.

The gastrophrenic mesentery is divided to the dia phragm. The peritoneal reflexion from diaphragm to esophagus is severed. The technique differs from that of Lewis in that the right crus of the diaphragm is sectioned. At this point care must be taken not to injure the thoracic duct or the right inferior phrenic artery. The esophagus is freed from the mediastinum for about 2 inches and the abdomen is closed.

In the second stage of the operation the right chest is opened through the bed of the fifth, sixth, seventh or eighth rib, depending upon the level of the lesion. The mediastinal pleura is opened from 3 inches above the lesion inferiorly to the vertebral bodies and the lesion of the lung root. The cause of inoperability of the aorta are most frequently the cause of inoperability. When operability has been established and the esophagus has been freed the nodes about the esophagus in the chest and the nodes about the esophagus are sectioned away and left on its junction with the aorta and the stomach is closed with three rows of sutures. The stomach is then sutured to the esophagus with one row of interrupted sutures and this on transected one clamp only being used. and this on the distal side. The point of section is preferably 3 inches proximal to the anastomosis. The stomach is sutured to the diaphragm and mediastinal arch is sutured to the diaphragm and mediastinal pleura. Intercostal drainage is used for 48 hours. Since acceptance of the article for publication 5 additional resections have been done by this method.

ROBERT E. FROEY, M.D.

Syndrome of Pancoast. Tobias in a Case of Primitive Carcinoma of the Esophagus (Syndrome of Pancoast). Tobias. *Ann. Surg.* 1948 129 615

The 52 year old male was a sort of maverick wandering about without family or means of support, he was admitted to the hospital in a confused mental condition and remained there under observation until he died 5 days later.

When first observed the patient stated that his symptoms had begun to develop about 3 months previously. He exhibited a massive edema of the entire right upper extremity, right upper third of the right shoulder and right side of the neck and face. About the root of the arm and over the shoulder and upper chest were an evident compressible venous congestion and dilatation. There was a typical Horner's syndrome of the right eye and paralysis of the right recurrent nerve (paralysis of the right vocal cord). The physical findings and roentgenological examination demonstrated massive involvement, apparently pressure of the second and third ribs on the right side. Fever was irregular and the patient constantly complained of pains in the right arm and latterly of headaches.

Autopsy disclosed an atypical pavement epithelial carcinoma of the upper third of the esophagus.



patients treated with penicillin administered intrapleurally. There were 20 adults and 10 children in the series.

In 27 patients the pleural process was believed to have followed acute lung disease. Three cases represented traumatic hemothoraces that became secondarily infected. A pneumococcus was the infecting agent in 53.3 per cent of the cases, a streptococcus in 6.6 per cent, and a staphylococcus in another 6.6 per cent. In 9 cases the pleural fluid was sterile when first seen. In 6 of these 9 patients however penicillin had been administered previously. The average total dosage per patient was 450,000 units. The pleural fluid became sterile after from 1 to 3 instillations although as high as 26 thoracenteses were required in one instance to complete the treatment. Sterilization of the pleural fluid alone was not considered an indication to cease treatment, and caution against too early suspension of therapy is sounded.

Penicillin was given systemically in addition to the intrapleural dose to the majority of patients because of the lung pathology or the advent of some complication.

Only one case is admitted to have become chronic. The follow-up on the majority of the remaining patients had been of 2 to 3 months duration and they are reported as being well. The duration of the illness up to the time of discharge however ranged from 32 days to 170 days, 8 of these patients having spent 60 or more days in the hospital, and 17 of them 60 or more days.

The data furnished is essentially statistical. No documentation by roentgenography is offered.

IRVING T. LANGSTON, M.D.

### HEART AND PERICARDIUM

*Anomalies of the Derivatives of the Aortic Arch System.* JESSE E. EDWARDS. *Med Clin. N. America*, 94:5, 9-5.

The primary purpose of this communication is to describe and to illustrate those anomalies of the derivatives of the aortic arch system which may interfere with the function of either the esophagus or the trachea. The subjects of persistent patent ductus arteriosus and coarctation of the aorta are not included. The majority of the anomalous configurations presented have been described. To these were added several configurations which, as far as the author knows, had not been reported heretofore. They stand out as distinct possibilities and consequently were included as hypothetical forms. This was done with the hope that when they are encountered they will be understood and not be viewed with undue surprise. Furthermore it is hoped that whoever observes these hypothetical possibilities will be stimulated to place them on record in order that the literature may contain a more comprehensive accumulation of this group of anomalies.

It is customary to employ the standard Rathke diagram of the six aortic arches in explaining the

developmental basis for the various anomalies of the aortic arches, and in relating the various types to each other. While this approach is perfectly logical and correct, the reader nevertheless, is likely to be somewhat confused. In the basic diagram of the six aortic arches, which is customarily employed the subclavian arteries lie caudad to the sixth arches. Yet, by the time of birth, important differences in the rates of growth of the portions of the aortic arch system result in the presence of the subclavian arteries in a cephalad position with respect to the sixth aortic arches.

The author believes that a better understanding of the relationship of the aortic arch anomalies, from a developmental point of view and with respect to each other, can be had by an approach other than the employment of the basic primitive and diagrammatic six-arch pattern. To the author it seems best to employ as the basic pattern an anomaly which, while it contains the essential features of the primitive aortic arch pattern, has also gone through the growth adjustments that take place in all persons.

The anomaly known as the functioning double aortic arch is chosen as the basic pattern. To fulfill completely the line of reasoning, this anomaly should contain right and left ductal arterialies, but usually only one ductus arteriosus is present. The one adjustment that the reader must make is to realize that the functioning double aortic arch represents, with one exception, the primitive aortic arch pattern, in which growth adjustments have taken place. The exception is that one of the sixth aortic arches has largely disappeared.

In the author's opinion, malformations of the aortic derivatives may be divided into two groups, depending upon whether the ductus arteriosus takes its origin from the left pulmonary artery or from the right pulmonary artery. These groups are explained at length in the author's paper. Arbitrarily in cases in which the ductus arteriosus arises from the left pulmonary artery the anomalies are classified under group 1 while in cases in which the ductus arteriosus takes its origin from the right pulmonary artery the anomalies are placed in group 2. Group 1 is by far the larger of the two. Although exceptions to the rule occur the upper portion of the descending aorta lies on that side of the body on which the ductus arteriosus is found.

In those cases in which the upper portion of the descending aorta lies on the right side the lower portion of the descending aorta crosses to the left at about the level of the body of the eighth or ninth thoracic vertebra to leave the thorax through the aortic hiatus.

If a patient suffers from symptoms resulting from an anomaly of the derivatives of the aortic arch system, certain rules concerning surgical therapy usually be followed. Relief may be obtained by division of the smaller of the two aortic arches, by division of that part of the arch which is atretic, by division of the ductus arteriosus, by dislocation of a common carotid artery or by division of a subclavian

# SURGERY OF THE ABDOMEN

## ABDOMINAL WALL AND PERITONEUM

**Peritoneal Reaction to Oxidized Cellulose.** EUGENE T. DIMITRIY. *Arch Surg.*, 1948, 56: 386

Oxidized cellulose has recently been added to the armamentarium of the surgeon, a gauzelike material which is completely absorbed in the tissues and serous cavities. Its physical and chemical properties have already been described in the literature.

There has always been some concern expressed about leaving nonabsorbable materials in the tissues and especially in the serous cavities with a certain degree of impunity. Gauze sponges and packs have been left in the serous cavities with untoward results such as empyema, fistula formation and intestinal obstruction. They have also been left in the serous cavities for hemostasis and when they have been removed hemorrhage has often recurred or infection has been introduced.

The use of oxidized cellulose with thrombin as a hemostatic agent has been studied. A specific hemostatic action of its own which is due to the formation of a coagulum consisting of salts of cellulose acid and hemoglobin was observed. Oxidized cellulose has an untoward effect in bone. There is a delay in early callus formation in fractures which is due to the acidity of the gauze.

The primary reaction of traumatized peritoneum to oxidized cellulose is a fibroblastic proliferation. The connective tissue becomes flattened to produce a lining membrane.

Adhesions are formed between the omentum and intestine and the adjacent segments of intestine are present. The adhesions are permanent and are present after complete absorption of the oxidized cellulose.

The adhesions observed after immediate application of oxidized cellulose to the traumatized serosa are finer and less numerous.

The recurrence of adhesions cannot be prevented by oxidized cellulose.

HARRY W. FINE, M.D.

**Contribution to the Study of Pneumococcal Peritonitis** (Contributo allo studio della peritonite pneumococcica) GIRO TARTARINI. *Arch Ital Chir.* 1947 69: 311

The problem of pneumococcal peritonitis in spite of numerous contributions to the literature based on study, experience, and research has not been solved. The differential diagnosis between pneumococcal peritonitis and the crisis of acute appendicitis still creates a therapeutic dilemma. Whether surgical intervention in cases of pneumococcal peritonitis as in other types of septic peritonitis, or whether it should be delayed or even advised against, is still a debated question.

After discussing the etiology, pathogenesis, pathological anatomy, symptomatology, diagnosis, prognosis and treatment of pneumococcal peritonitis the author painstakingly reports the clinical history of 7 cases of pneumococcal peritonitis which occurred among a series of patients operated on in the Civilian Hospital of La Spezia.

The condition occurred in children all girls, of from 3 to 11 years of age. The disease is more common in children than in adults and is observed in girls more often than in boys. In 3 of the 7 cases the peritonitis was diffuse and in the remaining 4 the peritonitis was localized.

The first case was that of a girl of 9 years who was admitted to the hospital with a diagnosis of acute appendicitis. Physical examination revealed the presence of diffuse abdominal pain unaccompanied by muscular spasm. Examination of the lungs was negative. The patient suffered a severe persistent diarrhea which had been present since the onset of the disease. Vomiting was considered marked. Pneumococcal peritonitis was considered in differential diagnosis, but there was absence of labial herpes, vulvitis, and other extra-abdominal signs of the disease. Exploratory puncture was not made. Leucocytosis was present (20,500 white blood count with 92 per cent polymorphonuclear neutrophils). After a stormy period of remittent fever the patient developed signs of a localized abscess above the umbilicus. On the fifteenth day of the disease a midline incision above the umbilicus was made with the discovery of purulent peritonitis in the evacuated pus from which was identified the pneumococcus. Drainage was instituted and recovery was gradual. In the author's opinion a diagnosis of acute appendicitis was not justified in this case. The abdominal pain which was diffuse never became localized in the right lower quadrant. It was unaccompanied by muscular spasm on palpation. From the onset of the disease the patient suffered a persistent diarrhea a symptom which is rarely prominent in patients with appendicitis. Diarrhea occurs chiefly in those cases in which the appendix lies within the pelvis and it is not persistent or particularly severe. Vomiting was present, but not characteristic of that accompanying appendicitis. When signs of a localized abscess did appear the localization was above the umbilicus.

The second case occurred in a girl of 4 years. The onset of the condition was accompanied by fever and persistent cough with scant expectoration. Bilateral bronchopneumonia was found in an x-ray examination of the chest. On the fourth day after the child's entry into the hospital a painful swelling unaccompanied by muscular spasm appeared in the abdomen. Diarrhea was present and vomiting occurred only once. Tuberculous peritonitis was considered as the diagnosis. Two days later a swelling appeared over

which had sprouted out into the right lung and spread into the right apical region of the chest, displacing downward and compressing the pulmonary tissues of the apex of the lung. The process had metastasized to the mediastinal and supraclavicular lymph nodes apparently on both sides of the neck and to the liver.

In the author's opinion this case of esophageal cancer verified at autopsy demonstrates that any sort of tumor of the upper mediastinum primitive or metastatic, is capable of producing a complete Pancoast-Tobias syndrome without reference to a primitive or metastatic malignant tumor within the parenchyma of the lung itself (upper lobe tumor of Pancoast). J. H. W. BREXNA, M.D.

**Fibrosis of the Mediastinum with the Syndrome of Pancoast** (Fibrosis del mediastino con sindrome di Pancoast). F. MARCOLONGO and P. C. FERABOLI. *At necrosc. Tor.* 948, 30-6.

The authors report the case of a 27 year old female who at 11 years of age had noted a weakening and atrophy of the left upper extremity which was especially evident in the hand. At about this time there appeared engorgement of the veins at the root of this arm and also at the base of the neck. This condition gradually became worse without, however, the development of any other symptoms worthy of note. A year previous to the time the patient was first observed a ptosis of the left upper eyelid developed and only a month previously there appeared a sudden burning pain extending downward along the left arm. At this time there appeared an irregular fever oscillating from 38° to 39° centigrade and the patient gradually lost 10 kgrm. in weight. At examination the patient presented in addition some anemia and the roentgen examination disclosed a solid appearing sharply delimited tumor in the upper region of the left thorax which extended from the plane of the vertebral column which was pushed to the right, out to the left axilla. There was some enlargement of the left axillary lymph nodes and a dense homogeneous mass which was painful to pressure. A biopsy specimen from this mass disclosed histologically a simple fibroma. Pulsus differens and a difference in the blood pressure measurements on the two sides (left, 80/50 right, 115/65) were present.

Through an ample thoracotomy (third fourth and fifth ribs) the mass was successfully removed however after a period of 3 days the patient began to exhibit symptoms of collapse and she died on the

fifth day after the operation. At autopsy, degenerative signs were observed in the liver and kidneys and a brown atrophy of the myocardium was present. The tumor mass, which was 14 by 10 cm. in size proved again to be a fibroma without a mixture of other tissues. There were extensive necrotic areas involving the medial and anterior portions of the tumor.

The author designates the symptoms here present as a Pancoast syndrome although when that author described the condition in 1924 he intended it to apply only to malignant tumors of the pulmonary apex. It is believed that this is the first of these tumors to be diagnosed preoperatively.

JOHN W. BREXNA, M.D.

## MISCELLANEOUS

**A Study of Intrathoracic Cysts Arising from the Diaphragm.** P. E. A. NYLANDER and S. J. VIKARI. *Scand. J. Clin. Lab. Invest.*, 1948, 37: 99.

Three cases of cysts in close relation with the diaphragm and located near the pericardium are reported. These cysts varied in size from that of a goose egg to one which was 23 by 23 cm. in size. Histologically the cysts were similar in that there was a firm inner layer and a dense outer layer, the outer layer being more vascular. One cyst was lined by endothelial epithelium. All cysts were removed surgically.

In discussing the origin of these cysts the authors point out that in their 3 cases the location was in the ventral median part of the right half of the diaphragm. They believe that Broman's investigations throw some light on the origin of these cysts. According to Broman the bursa infracardiac is a remnant of the right pneumatoenteric recess developed from the original pleuroperitoneal colonic cavity. The cranial part of the original recess becomes isolated and remains, as a bursa infracardiac, between the esophagus, the right lung, and the right half of the diaphragm. There are a bursa at first on both sides of the esophagus but the left one usually becomes atrophied. In some mammals this structure is larger than in man and the size varies greatly. Therefore it would seem natural for a bursa to persist as a cyst. In diagnosis roentgenology is the most helpful method. In one case the author used a diagnostic pneumothorax. Bronchoscopy and bronchography are not particularly useful in diagnosis of these cysts. Treatment of these cases is operative.

ROBERT E. FLORES, M.D.

# SURGERY OF THE ABDOMEN

serum therapy, sulfonamides, and penicillin with the hope of ameliorating symptoms and modifying the prognosis of the individual case.

BLACKWELL, MARSHALL, M.D.  
AND ALAN H. HUNT

**Stainless Steel Wire for Abdominal Incisions and Hernias.** A. LAWRENCE ARNOLD and ALAN H. HUNT  
*Brit. M. J.*, 1948, 2, 379

Stainless steel wire was introduced for the closure of abdominal incisions by Babcock in 1934. The authors consider that the elimination of postoperative disruption is one of the most compelling factors in choosing stainless steel wire rather than catgut silk or thread in the closure of abdominal incisions. Abdominal disruption is due to one or more of the following causes: (1) interference with healing, or the dissolution of recently healed tissues by a local infection or by digestive enzymes; (2) a disruptive force such as vomiting or sneezing; (3) distention, hiccupping or coughing; (4) the strength of a wound correctly closed with stainless steel wire is unaffected by time and is sufficient to withstand more than normal strains. It should therefore be used when there is any factor of dietary deficiency or when there is any evidence of malignant disease or jaundice. Wound infection accelerates the dissolution of catgut and also prevents normal healing. The same effects are presented by wounds bathed with biliary pancreatic, or other digestive ferments. If nonabsorbable ligatures such as thread and silk are used infection penetrates into the interstices between the filaments and cannot be thrown off by the body.

The materials have themselves been discharged until the ligatures have a single inert filament of granula. Stainless steel wire is a single inert filament of granula on concealment or retreat for micro-organisms. No matter how serious an infection is present, the wire is in over it without any risk of introducing heat sterilized, and there is no risk of introducing infection. The strength of stainless steel wire is such that no disruptive force can burst a wound which is closed in one of the manners suggested. Confidence in the abdominal closure is easily transmitted to the patient, who is thus more likely to co-operate willingly in getting out of bed within or about 24 hours after the abdominal operation.

The authors' experience dates from 1938 when wire sutures were adopted for the closure of all abdominal wounds, especially in the presence of postoperative infection and in cases of malignant disease. This practice was later extended to the repair of large incisional hernias and to other types of hernia requiring reinforcement of the defect. Thus far stainless steel wire sutures have been used in more than 500 major abdominal incisions in seriously debilitated individuals without a single instance of abdominal disruption or postoperative herniation. In the past 4 years more than 300 hernial repairs have been made with stainless steel wire sutures.

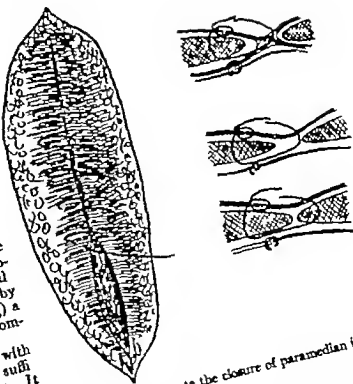


Fig. 1. To illustrate the closure of paramedian incisions, the wire being retained.

Stainless steel alloy wire is not resorbable in the body fluids. The tissues react to its presence by the formation of fibrous tissue but no inflammatory or foreign body response occurs. The wire acts as a framework over which the body deposits a dense mat of fibrous tissue over a narrow zone the scar does not stretch. The wire suture does not act as an impediment to the healing of wounds infected at the time of operation or later.

In using wire sutures a principle must be adhered to. The anatomical relations of the parts sutured and tension leads to tissue necrosis. Stainless steel sutures must therefore be laid in the tissues without tension. The dissection prior to suturing or darning need involve only the immediate vicinity of the defect concerned. Fascial planes are thus not disturbed beyond a limited definition of the tissues and secondly the wire must never be used in its break at a kink. Care must therefore be used in its introduction into the tissues.

The first complete stitch is passed through the tissues and the wire tied in a close reef knot so that the suture is taut but not tight. The short end is then gripped against the knot with a pair of artery forceps, cut level with the blade of the forceps and the stump twisted 180 degrees into the adjacent tissue. In this subjects with little subcutaneous tissue it is advisable to cut the loose end of the wire flush with the knot.

In abdominal incisions of patients of normal build the peritoneum together with the posterior

the right trochanter. On exploratory puncture of the abscess the pus obtained revealed gram-positive diphtheroids. Operation on the fifteenth day of the disease through a midline incision below the umbilicus revealed a pneumococcal peritonitis, the causative agent being proved by bacteriological examination of exudate from the abdominal cavity. Drainage was instituted the trochanteric abscess was also drained. Recovery was gradual.

The third case of pneumococcal peritonitis occurred in a girl of 3 years, who was first admitted to the pediatric service for the treatment for worms. After some improvement following treatment, she developed a diarrhea remittent fever, and diffuse abdominal pain. She was then transferred to the surgical service. Examination of the chest was negative the throat was inflamed. The following day the fever subsided the diarrhea was checked and meteorism with a soft abdomen appeared. Pneumococcal peritonitis was suspected and a positive blood culture was obtained. A localized abscess developed in the region of the umbilicus. On the sixteenth day operation was performed with drainage of the abscess. Recovery was gradual. This was a classical case of pneumococcal peritonitis with typical onset intestinal signs with peritoneal invasion diarrhea, diffuse abdominal pain, remittent fever soft abdomen subsiding pain followed by meteorism, a positive blood culture, and signs of the development of a localized abscess in the second week. Operation on the seventeenth day revealed a circumscribed abscess below the umbilicus. Pneumococci were present in the purulent exudate from the abdomen. Recovery was gradual.

The fourth case occurred in a girl of 7 years, who was admitted to the hospital with a fever thready pulse intense dyspnea, extreme abdominal pain parched tongue sunken eyes, but with no herpes or vulvitis. Examination of the chest and respiratory tract was negative. The abdomen was distended and diffuse abdominal pain was present on palpation. After hospitalization for 3 or 4 days, some improvement was noticed then signs of a diffuse peritonitis appeared. Operation was performed with findings of a diffuse peritonitis which was due to the pneumococcus. Drainage was instituted. The patient died a few hours after intervention.

The fifth case was that of a girl of 8 years who entered the hospital for the relief of severe pain in the lower quadrant and fever. Prior to entry she had been troubled with meteorism and constipation. She had been purged. Physical examination revealed a patient with flushed face, a negative thorax, diffuse abdominal pain, more marked in the right lower quadrant and accompanied by slight muscular spasm in this region. There was present a vulvitis but there were no organisms demonstrable in the vaginal secretions. Blood examination revealed a leucocytosis of 23,500, but the blood culture was negative. On the eighth day of the disease operation was performed through a right rectus incision. A small amount of purulent exudate exuded from the

wound. The appendix was inflamed. An appendectomy was done and drainage instituted. The exudate showed pneumococci. Recovery was gradual.

The sixth case was that of a girl of 11 years, who entered the hospital for the relief of abdominal pain nausea and fever. After her entry these symptoms began to subside and a diarrhea developed. A few days later an umbilical fistula developed spontaneously through which exudate from a supposedly localized abscess flowed. Operation through a midline incision below the umbilicus was performed and drainage of a diffuse peritonitis was done. The causative agent was proved to be the pneumococcus. Recovery was gradual, with the development of an umbilical hernia which was later repaired.

The seventh case was that of a girl of 10 years, who was admitted to the pediatric service with a diagnosis of gastroenteritis. She had a past history of chronic indigestion. Five days before entry she had developed violent abdominal pain, vomiting, and diarrhea. These symptoms abated and a localized abscess beneath the umbilicus developed. A blood culture was positive for pneumococcus. Drainage of the peritonitis was carried out on the nineteenth day and recovery was gradual.

The author concludes from these cases that herpes labialis is not a constant sign of this disease and that it is difficult to demonstrate the presence of the pneumococcus in the blood and vaginal secretions. He considers the presence of vulvitis to be a very good presumptive sign and that the most important diagnostic element is diarrhea which is persistent, tenacious and initial. In all cases there is a severe onset with remittent fever, and acute diffuse abdominal pain unaccompanied by muscular spasm.

The possibility of an early diagnosis of pneumococcal peritonitis depends upon the recognition in female children of the presumptive signs of herpes labialis, vulvitis, catarrhal inflammation of the respiratory tract, abrupt initial high fever with rapid remission diarrhea vomiting and diffuse abdominal pain unaccompanied by muscular spasm. To differentiate the condition from the onset of acute appendicitis is difficult. On account of this last fact, intervention is indicated immediately by many writers. The author recommends temporary supportive measures during the first 24 to 48 hours, until either the abdominal pain localizes or the acute initial symptoms begin to subside. In cases of circumscribed peritonitis he advises prompt drainage of the abscess. In diffuse peritonitis he advises waiting until localization of the abscess occurs.

The author advocates general anesthesia except in cases in which the general condition of the patient is very grave. Under these conditions, local anesthesia is advocated. In all cases he advocates simple drainage without appendectomy. A midline incision above or below the umbilicus is employed depending upon the accessibility of the most dependent point of drainage of the abscess.

In the author's experience biological treatment has not met with success. In grave cases he employs



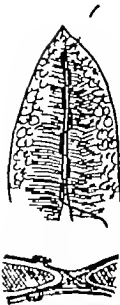


Fig. 2. Illustrate the closure of paramedian incisions when the wire is to be removed.

rectus sheath above the semilunar fold of Douglas is closed with a continuous catgut stitch in the usual manner. The muscle and the anterior sheath are then closed with a running figure-of-eight stitch (Fig. 1). In thin patients it is better to use interrupted sutures and to cut each wire flush with the knot or to use an alternative method as illustrated in Figure 2.

The technique of closure of hernial defects is described.

With little experience wire sutures can be handled with ease. Speed comes with practice. In respect to tensile strength, holding power, absence of inflammatory and foreign-body reaction, rapidity of healing, and to reduction of complications in an infected wound, stainless steel is better than catgut, linen or cotton thread or silk. Tantalum wire induces the same favorable response on the part of the tissues. It is easier to use and has less tendency to kink than stainless steel. It is, however, not as strong and is more brittle in the knot.

In about 1 case in every 200 a broken end of wire causes discomfort to the patient and needs to be removed under local anesthesia. This trouble has occurred in midline and paramedian abdominal closures in thin patients. In no case has the wire or a fragment of it, burrowed into the tissues more deeply and caused trouble.

The reopening of an abdominal incision closed with wire takes a little longer than that of one in which catgut or thread has been used but the method is easy. The skin and subcutaneous tissues are incised down to the wire loops. These are then defined sufficiently to be pulled up and divided between artery forceps, and the separate segments are then pulled

out, care being taken to remove the whole wire. The knife blade used for this part of the incision is rendered useless for further work. There is no difficulty in closing a wound with wire for a second time.

ROBERT TOWELL, M.D.

**The Surgical Treatment of Strangulated Obturator Hernia (A proposito del trattamento chirurgico dell'ernia otturatoria strozzata)** VITTORIO PATTINARI. *Ann. Ital. chir.* 1948, 25: 1.

The author describes the surgical treatment of obturator hernia using the external approach. An ample incision is made along the adductor muscles parallel to the gracilis muscle and the thigh is kept in flexion on the pelvis in abduction and external rotation with the heel resting on the opposite knee. The pectineus muscle is then cut near the pubic insertion and retracted distally. To attempt to go through the muscle would interfere with proper exposure, especially in the case of a strangulated hernia. The superior border of the obturator foramen must be properly exposed and in order to accomplish this, Gimbernat's ligament and the crural arch are exposed. The latter is sectioned at the junction of the middle and medial thirds and the obturator foramen is thus exposed. The hernial sac is then opened, and the hernia is reduced. In the event that it is necessary to resect the bowel or exposure is not sufficient, one may extend the incision at the crural arch and then enter the peritoneal cavity and treat the hernial content in the best possible manner.

Repair of the hernia is made by the sectioned crural ligament which is transposed to cover the obturator foramen. The ligament is cut in such a way as to form a triangular limb which is then turned down completely to cover the obturator foramen, and fixed with several sutures. Above this is sutured the pectineus muscle. In all these maneuvers, the obturator nerve is carefully guarded.

The author states that use of the sectioned crural arch is also made in the repair of inguinal hernia with good results. As to the possibility of its causing a weakening of the anterior abdominal wall, the author believes this to be more theoretical than real. Moreover the procedure is usually followed in the cases of older women in whom the danger of inguinal hernia is minimal since they do not, as a rule, perform heavy work.

The objections to the external approach of those who favor the abdominal or internal approach, are discussed.

LUCIAN J. FROMMELT, M.D.

## GASTROINTESTINAL TRACT

**The Relationship of Bone Trauma to the Development of Acute Gastrointestinal Lesions in Experimental Animals and in Man.** STANLEY E. FRIEDMAN, K. ALVIN MEREDITH, IVAN D. BARONSKY, FREDERICK B. MEARNS, and OWEN H. WANGENSTEEN. *Surgery* 1948, 24: 124.

The mechanism of fat embolism following fracture as stated by Warthin is a release of liquid fat from

TABLE I

Group	Animal N	Weight in Grams	Days Histamine Administra- tion	Bleeding	Perforation	Remarks
1	3		44			Sacrificed, no ulceration present
	4	0	44			Sacrificed, one small duodenal ulcer
	6	6	3			Sacrificed, one small superficial duodenal ulcer
	5					Sacrificed, one small ulcer 1.5 mm
	7	7	7	+	0	Died, numerous ulcers of duodenum and proximal jejunum
			6	+		Died, extensive ulceration of duodenum and jejunum and erosion of mucosa of esophagus
	5	4	4	++		Sacrificed, multiple duodenal ulcers, esophageal ulcers extensive gastritis
	6		6	+		Sacrificed 4 duodenal ulcers, hemorrhage, from antrum of stomach
	7	302		+		Died, extensive ulceration of duodenum and jejunum; one ulcer in stomach 3 cm. in diameter
	8	30	4	++		Sacrificed, multiple duodenal ulcers, an ulcer in antrum of stomach
2	9		3	+		Died, 4 duodenal ulcers
		9	6	+		Died, multiple duodenal ulcers
	A 8	9				Died, no ulceration present
	A 9	85	3			Died, one large perforated duodenal ulcer
	A	93	3			Died, no ulceration
4	A	7				Living, no evidence of ulcer

\*These four groups of animals received 5 mgm. of histamine-in-beeswax intramuscularly per kilogram of body weight daily. Group 1 control experiments, Group 2 total extirpation of pancreas, Group 3 ligation of both pancreatic ducts, and Group 4, rendered diabetic by administration of alloxan.

†Summary of all lesions is given graphically in Fig.

‡This animal received only 10 mgm. of histamine-in-beeswax daily

total pancreatectomy comprised group 2 dogs in which the pancreatic ducts had been ligated comprised group 3 and dogs made diabetic by the administration of alloxan comprised group 4. All of the animals received similar intramuscular injections of histamine in beeswax by the technique of Hay Varco Code and Wangenstein.

A large series of dogs which had been pancreatectomized and maintained for a long period on a dietary regimen identical to this group also at the Surgical Research Laboratory of the University of Texas served as controls to demonstrate that ulcers do not develop spontaneously in these animals. Ligation of the pancreatic ducts was performed in 3 other dogs which were used as additional controls for group 3 and their sacrifice 2 months later showed that no ulcers had developed spontaneously. The milk and meat diet appeared to be adequate to protect against ulcer formation. Atrophy of all the pancreas except a thin cord of islet tissue indicated that complete blockage of the ducts was obtained.

The pancreas of the dogs in group 2 was totally extirpated by careful blunt dissection and the main duct ligated. Postoperatively careful management and replacement therapy maintained these animals in good condition indefinitely. Milk and corn syrup after 12 hours and ground raw horse meat mixed

with lecithin and pancreatin after 3 days constituted the diet. Two weeks postoperatively insulin was given and fasting blood sugar levels from 217 to 370 mgm. per cent indicated the completeness of the pancreatic extirpation. Histamine injections were not started until 2 weeks after operation.

The animals in group 3 had both pancreatic ducts isolated and cut between cotton ligatures. The pancreas was completely separated from the duodenum and a bit of omentum interposed. Postoperative care and feedings were the same as for the pancreatectomized animals except that the administration of insulin was not necessary.

For the purpose of studying the effect of eliminating the action of insulin the dogs in group 4 were made diabetic by the administration of 75 mgm. of alloxan per kilogram of body weight. The degenerative changes on beta cells by the action of alloxan are not readily accomplished in dogs so it was necessary to withhold food for 72 hours to render the 4 animals diabetic. After stabilizing these animals on daily insulin therapy to maintain reasonable blood sugar levels on the standard milk and meat diet daily injection of histamine-in wax was started.

A dosage of 5 mgm. of histamine-in beeswax per kilogram of body weight was administered daily. The animals were sacrificed when they showed signs



The Lytic Action of Saliva on Gastric Mucin from Patients with Ulcer in Relation to the Pathogenesis of Gastric Ulcer (Il potere litico della saliva degli ulcerosi sulla mucina gastrica in rapporto alla patogenesi dell'ulcera gastrica) **PERRIO MAJONE.** *Riforma med.* 1915, 611-97.

The author discusses the relation of gastric mucin to ulcer formation. It has a triple action: mechanical, chemical, and biological. Following his experiments on the action of saliva upon gastric mucin he arrives at the following conclusions:

1. Gastric mucin in normal individuals, as well as in those with peptic ulcer, loses its viscosity in time, perhaps through the mucinase action of enzymes contained in the mucin itself.

2. The saliva of normal individuals has a minimal lytic, hence negligible, action upon their own gastric mucin as well as upon the gastric mucin from patients with ulcer.

3. The saliva from patients with peptic ulcer possesses intensive lytic action upon normal gastric mucin as well as upon gastric mucin from patients with peptic ulcer, diminishing its viscosity.

4. The mucinolytic property is specific for saliva from patients with peptic ulcer.

In view of this data, the author believes that the protective action of gastric mucin is deficient in ulcer patients and this loss is due to the diminished viscosity of the mucin rather than upon a diminished quantity. This view is further substantiated by the fact that there is a difference of opinion as to the amount of mucin found in patients with peptic

ulcer. Reference is made to different authors, some of whom maintain that gastric mucin is decreased while others maintain that gastric mucin is increased in patients with peptic ulcer.

LUCIAN J. FROMMELT, M.D.

The Relation of Pancreatic Secretion to Peptic Ulcer Formation. Effect of Pancreatic Ligation of Pancreatic Ducts, and Diabetes on the Production of Histamine-Induced Ulcers in the Dog. **EDGAR J. FOTE, LOUIS J. MANSFORD, JR., and A. WILLIAM DELOACH.** *Surgery* 915, 24, 62.

The relationship between pancreatic secretion and peptic ulcer formation has been observed for some time. This relationship is now more important because of the advent of vagotomy and its possible modification of the effective parasympathetic innervation of the pancreas and the subsequent influence upon secretory activity. Duodenal ulcers may be produced by the deviation of the alkaline secretion of the pancreas through external fistulas, or the internal duodenocolic fistula, and by ligation of the pancreatic ducts. The occurrence of these ulcers has usually been considered the result of depriving the duodenum of the neutralizing influence of the bile and pancreatic secretions on the acid effluent from the stomach. When the duodenum is deprived of alkaline secretion by pancreatic duct ligation, duodenal ulceration rarely supervenes. The difference may be that whenever the pancreas is present and the external secretions are excluded from the bowel in immediate contact with the gastric secretions, ulcers develop, while with simultaneous removal of the internal secretions by pancreatic duct ligation ulcers do not develop when the external secretions are excluded, because the blood sugar remains at a relatively high level without the stimulating effect of hypoglycemia on the acid secretion by the glands of the stomach.

Investigators have reported the incidence of experimental peptic ulcer following external pancreatic fistulas as being almost 100 per cent, following ligation of the ducts 29 per cent, and following pancreaticotomy 13 per cent. It may appear that ulcer formation in these situations is not explained adequately by failure of neutralization in the duodenum of the acid effluent of the stomach by the diverted alkaline secretions, and the question is advanced whether the pancreas has an intrinsic influence upon ulcer formation other than that of mere alteration of the duodenal contents.

Statistical studies indicate that peptic ulcers develop infrequently in diabetic patients. From 50 per cent to 40 per cent of diabetic patients exhibit acidity, which may be a related factor.

Both the internal and external secretions of the pancreas may be implicated in ulcer formation. This study concerns certain aspects of the influence of the secretory activity of the pancreas upon the formation of ulcers induced by continuous histamine stimulation of the dog.

Sixteen dogs were divided into groups of four. The controls were placed in group 1, dogs having

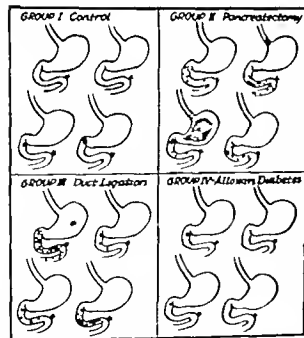


Fig. 1 (Fote et al.) Schematic demonstrations of the extent and distribution of ulcerations caused by histamine-beeswax with the alterations of pancreatic status.

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Small Bowel Segment	Pathologic Types	Total	Malignant Benign	→ Intussusception Malignant Benign
Duodenum	I		Carcinoma Melanoma	3 Malignant → Intussuscepted
	II Adenocarcinoma Melanoma			Benign → Intussuscepted
	III Adenocarcinoma			
Jejunum	I Polyp Adenocarcinoma Small-celled carcinoma Leiomyosarcoma	4	Carcinoma Leiomyosarcoma	5 6 Malignant → Intussuscepted
	II Carcinoma Adenocarcinoma		Polyp	Benign → Intussuscepted
	III Adenocarcinoma			
Ileum	I Submucosa fibroma Leiomyosarcoma		Carcinoma Lymphosarcoma Spindle-cell sarcoma Leiomyosarcoma	4 Malignant → Intussuscepted
	II Fibroma Spindle-cell sarcoma			
	III Submucosa lipoma Pseudoglandular fibroma Intramural fibroma	6	Fibroma Lipoma Leiomyoma	4 6 Benign → Intussuscepted
	III Leiomyoma Adenocarcinoma Lymphosarcoma			
		20		13 Malignant → 3 Intussuscepted 7 Benign → 4 Intussuscepted

anastomosis. In this group 3 deaths occurred in the immediate postoperative period, 1 from shock and 1 death from pneumonia. Four patients died of metastases, in 3 months, 18 months, 19 months, and 20 months, respectively following resection. One patient with extensive ileocolic and rectal sarcomatosis was carried along favorably with deep x-ray therapy and was living and well 18 months after resection. Only 2 patients are living and entirely free of recurrence 18 months and 3 years respectively after resection. Both of these patients had resections for leiomyosarcoma. The 3 patients who were not operated upon died shortly after admission. Resection was performed in all 6 cases of benign tumors—side-to-side anastomosis being done in 5 cases and end-to-end anastomosis in 1 case. Three of the patients died—2 following operation and 1 in 6 months from an antecedent carcinoma of the cervix. The 3 remaining patients recovered and are well.

All patients with carcinoma succumbed because of the intrinsic malignant disease which established the fact that with the present treatment of malignancies of the small bowel the over-all prognosis is extremely discouraging.

An exhaustive review of the literature concerning tumors of the small bowel is presented and the 19 cases in this series are discussed in detail.

EARNEST D. BLOOMENTHAL, M.D.

Ileus in the Course of Acute Appendicitis (Ileus im Verlauf der akuten Appendicitis) GEORGE SCHÖNKE, *Chirurg* 1948 19 105

Ileus may be the cause as well as a sequel of acute appendicitis. As an example of the first possibility the author refers to a case in which partial obstruction by a carcinoma of the ascending colon led to an acute appendicitis caused by the accumulation of feces. On the other hand symptoms of a paralytic ileus can be produced in the very beginning of a severe attack of appendicitis without the presence of generalized peritonitis.

While these are comparatively rare occurrences ileus is a frequent postoperative complication. It is of greatest importance for a correct prognosis and treatment to differentiate between paralytic and mechanical ileus although mixed forms of both types occur and may complicate the evaluation.

In most cases paralytic ileus is a sign of generalized peritonitis. However laparotomy often reveals that only a small part of the peritoneum is involved in spite of a complete paralytic ileus. In such cases early surgery may save the patient.

Mechanical ileus may be caused by adhesions, kinking or strangulation of a loop of the small intestine or by volvulus or intussusception. These complications occur as a rule in a late stage of appendicitis with or without operation.

of having developed an ulcer such as anorexia, vomiting, bloody stools, and ill appearance (Table I).

The control dogs in group 1 were divided into two groups: 3 dogs received a dog biscuit diet and 3 received the standardized diet (meat and milk) fed to all animals included in this study. The 3 animals on the routine dog biscuit diet developed typical single ulcers in the first part of the duodenum. The 3 dogs on the standardized meat and milk diet showed no signs of ulcer development; they were sacrificed on the forty-fifth day and one had a single small duodenal ulcer and the other none. Apparently the meat and milk diet prevented ulceration in one dog and ameliorated it in the other.

In the depancreatized dogs (group 2), severe multiple ulceration of the duodenum developed within 4 to 7 days of histamine administration. Two of these animals died; 3 had perforations and bleeding occurred in all 4 dogs.

Three of the 4 dogs with ligated pancreatic ducts, in group 3, died within 6 days. Three had perforations and all showed gross bleeding.

None of the animals with alloxan diabetes, in group 4, showed signs of ulcer formation. A single duodenal ulcer was present in one of the dogs.

These studies did not demonstrate that diabetes alters the tendency toward histamine-induced ulcer formation. No inhibitory effect on the formation of peptic ulcers was produced by the diabetic state. A point of practical significance derived from the experiments is that removal of the pancreas or ligation of its ducts as is frequently performed in surgical procedure is not without some danger of postoperative ulceration. It would seem advisable to reanastomose the pancreatic duct to the duodenum or jejunum whenever possible following resection of the head of the pancreas.

ERNEST D. BLOOMENTHAL, M.D.

**Tumors of the Small Intestine.** HOWARD A. WEINBERGER and RUDOLF M. PALTAUT *Surgery* 948  
24 35

Tumors of the small bowel are rare in comparison to tumors which are situated at the extremities of the gastrointestinal tract. It is important to diagnose and treat tumors of the small bowel because they are extremely lethal.

In a span of 40 years, 20 primary tumors of the small bowel were discovered at the Lenox Hill Hospital in New York City. Ampullary tumors of the duodenum were omitted because they are probably of duct origin. During this period, 1,400 neoplasms of the gastrointestinal tract were observed, thus establishing a rate of 1 small bowel tumor to every 71 neoplasms elsewhere in the gastrointestinal tract.

Only 19 cases were available for study as the clinical record of one case was missing. Thirteen of the lesions were malignant and 6 were benign. The distribution between men and women was about equal. The average age of patients with benign tumors was 45 years and of patients with malignant tumors, 5 years.

Among the patients with malignant tumors, there was no instance of acute fulminating onset without preceding symptoms and the average duration of symptoms here was 10 months (from 1½ to 48 months). In the group with benign tumors, the duration of symptoms varied from an acute fulminating onset, due to sudden intestinal obstruction, to a period of 36 months.

In patients with malignant tumors, usually the chief symptom was pain. This occurred in 9, or 70 per cent, of the 13 patients and was usually described as abdominal discomfort of an intermittent aching character. Six patients manifested bleeding and 4 complained of diarrhea, constipation or alternation of the two. Weight loss, anorexia and cachexia were present in 11 of the 13 patients. Seven exhibited obstructions, and in 5 there was a palpable mass.

Of the 6 patients with benign tumors 4 complained of pain. Diarrhea and constipation were noted in 3 patients and bleeding occurred in 1 patient. Obstruction occurred in 3 cases and a mass was palpable in 3.

The symptoms varied from minor gastrointestinal distress to acute fulminating obstruction. Patients with persistent unexplained gastrointestinal complaints should be subjected to a careful roentgen examination of the small bowel pattern, as well as a roentgenological study of the remainder of the gastrointestinal tract. It may be necessary to resort to exploratory laparotomy.

In 6 instances of malignant and in 3 instances of benign tumors, x-ray studies were not made, usually because obstruction was present, or the patient was in extremis on admission. In the remaining 7 patients with malignant tumors, obstruction was demonstrable in 4 by roentgen examination. In one of these obstruction was interpreted as due to neoplasm. Two of the 7 cases studied by x-ray examination exhibited what were interpreted as filling defects due to tumor.

In the 3 cases of benign tumors which were subjected to x-ray study 1 tumor was registered as a negative examination, 1 as a mechanical obstruction of the ileum, and 1 as a filling defect. X-ray studies of the small bowel are generally not as satisfactory as those of the stomach or colon. Careful serial fluoroscopy and flash films of the small bowel following barium ingestion are essential.

The types of tumors encountered with their location, and the intussusceptions are listed in Table I.

It was interesting that 3 tumors of the duodenum were malignant and intussuscepted. Six tumors of the jejunum were malignant and 1 was benign and of these 4 were intussuscepted. Four tumors of the ileum were malignant and 6 were benign, and half of each of these were intussuscepted. The fact that lymph node metastases were largely concentrated in the large nodes at the root of the mesentery near the large mesenteric vessels made resection doubtful or impossible.

Ten of the 13 patients with malignant tumors were operated upon; 8 undergoing primary resection with

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J JEJUNUM	I Polyp Adenocarcinoma Small-cell carcinoma Leiomyosarcoma	4	Carcinoma Leiomyosarcoma	6 Malignant → 1 Intussuscepted
	II Carcinoma Adenocarcinoma		Polyp	1 Benign → Intussuscepted
	III Adenocarcinoma			
Ileum	I Subserous fibroma Leiomyosarcoma		Carcinoma Lymphosarcoma Spindle-cell sarcoma Leiomyosarcoma	4 Malignant → Intussuscepted
	II Fibrous Spindle-cell sarcoma			
	III Subserous Epithelioma Pedunculated fibroma Intramural fibroma	6	Fibrous Epithelioma Leiomyoma	6 Benign → 3 Intussuscepted
	III Leiomyoma Adenocarcinoma Lymphosarcoma			
		20		12 Malignant → 3 Intussuscepted 7 Benign → 4 Intussuscepted

anastomosis. In this group 3 deaths occurred in the immediate postoperative period: 2 from shock and 1 death from pneumonia. Four patients died of metastases in 3 months, 18 months, 19 months, and 20 months, respectively, following resection. One patient with extensive ileocolic and rectal sarcomatous was carried along favorably with deep x ray therapy and was living and well 18 months after resection. Only 2 patients are living and entirely free of recurrence 18 months and 3 years respectively after resection. Both of these patients had resections for leiomyosarcoma. The 3 patients who were not operated upon died shortly after admission. Resection was performed in all 6 cases of benign tumors—side-to-side anastomosis being done in 5 cases and end-to-end anastomosis in 1 case. Three of the patients died—2 following operation and 1 in 6 months from an antecedent carcinoma of the cervix. The 3 remaining patients recovered and are well.

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ERNEST D. BLOOMENTHAL, M.D.

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Ileus may be the cause as well as a sequel of acute appendicitis. As an example of the first possibility the author refers to a case in which partial obstruction by a carcinoma of the ascending colon led to an acute appendicitis caused by the accumulation of feces. On the other hand symptoms of a paralytic ileus can be produced in the very beginning of a severe attack of appendicitis without the presence of generalized peritonitis.

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In most cases paralytic ileus is a sign of generalized peritonitis. However, laparotomy often reveals that only a small part of the peritoneum is involved in spite of a complete paralytic ileus. In such cases early surgery may save the patient.

Mechanical ileus may be caused by adhesions kinking or strangulation of a loop of the small intestine or by volvulus or intussusception. These complications occur as a rule in a late stage of appendicitis with or without operation.

As to the medical treatment, the author believes that the management of hypochloremia dehydration and acidosis is most important. Repeated large blood transfusions prove much more effective than saline and dextrose. In addition the author recommends the administration of repeated hypertonic sodium chloride solutions intravenously (50 c.c. of a 9 to 10 per cent solution).

The patient should be operated upon as early as possible once the diagnosis of a mechanical ileus has been established. Many men are reluctant to operate a second time after appendectomy, however the author believes that expectancy involves a much greater risk.

The author has had no experience of his own with the Miller Abbott tube but stated that he believed this method could be tried preoperatively either to remove the mechanical obstruction or if this is not possible to create better conditions for subsequent surgery.

The different surgical methods are discussed in detail. The question whether one should try to visualize and manipulate the obstruction or whether one should confine oneself to a palliative operation (ileostomy) has been answered in different ways. In most cases ileostomy proximal to the obstruction is the operation of choice and gives good results provided the obstruction is not situated so high that there is danger of inanition. Only in rare cases is it advisable to perform at the same time an anastomosis between the ileum and colon.

WERNER M. SCHMIDT, M.D.

**Conservative or Operative Management of Appendicitis in the Intermediate Stage? (Konservative oder operative Behandlung der Appendicitis im Intermediastadium?)** HELMUT GÖTTKE. *Chirurg* 94:8, 9 52.

The present article is interesting particularly from the historical point of view in that the question of the management of appendicitis before abscess formation is still a very serious problem in European countries where antibiotics are unavailable. The author considers the "intermediate stage" that period of about 48 hours following the onset of symptoms (in some cases 3 to 5 days) during which there is the widest variation in the course of acute appendicitis.

A favorable course during this period occurs when the appendix is protected in some way from the rest of the abdominal cavity in which case either an inflammatory mass or an abscess ensues. An uncertain prognosis is given in the cases of those patients with a circumscribed peritonitis which may develop into a mass or an abscess, or may result in a diffuse peritonitis. A poor prognosis is given in those cases of generalized peritonitis which cannot be walled off.

The German literature of the past 20 years is reviewed and three schools of thought are represented. Kneumell, Lexer, Kirschner and Sudeck were advocates of operative management during this stage

of appendicitis except in cases in which a frank walled-off abscess could be palpated. Goetze, Reschke and Payr took a middle stand and recommended operation during this stage unless the appendix was ruptured in which event conservative treatment was advocated. The opinions of these authors varied slightly with regard to the time limit. Reschke suggesting 48 hours while Payr waited 3 days. A third school, consisting mainly of Jungbluth and Narath was considered the conservative group since they operated only on acute appendicitis without perforation leaving all other cases for conservative management.

After an extensive review of the mortality statistics from various European clinics which indicate that the mortality among patients operated upon rises sharply after the first 48 hours, the author arrives at the following conclusions:

Every acutely inflamed appendix should be removed within 48 hours of the onset of symptoms. Between 48 hours and 3 days the therapy varies from case to case. If the appendix is not yet perforated it is removed. If there is an inflammatory mass, this is removed with the appendix. If there is a free-lying appendix with a pericent peritonitis, the appendix is removed and the peritoneal cavity is drained. If there is an inflammatory mass plus a pericent peritonitis local drainage is done and later drainage through the pouch of Douglas. In some of these cases it is possible to remove the inflammatory mass and drain the area. In other cases technical difficulties may arise in which instance a completely conservative nonoperative course is followed. Late in the intermediate stage (4 to 5 days) a nonoperative course is suggested. For the clinically late cases of appendicitis with abscess, conservative management is followed. In cases of diffuse peritonitis, operation may be done up to the end of the third day after the onset, after the fourth day conservative management is suggested. Interval appendectomy should be done in from 6 weeks to 3 months after the attack, depending upon the individual pathology.

It is interesting to note that the conservative therapy outlined by this author does not include the use of antibiotics while it does include such questionable therapeutics as peritonitis serum, adrenalin, and intravenous calcium. HANOLD LUTTMAR, M.D.

**The Concept, "Mobile Cecum," and Its Surgical Management (Der Sammelbegriff "Cecum mobile" und seine chirurgische Behandlung)** HERBERT JOSEPH. *Chirurg* 94:7-8 53.

In the past forty years the clinical entity known as "mobile cecum" has acquired a large number of pseudonyms, and no less than 15 surgical procedures have been advocated for its correction. The purpose of this article is to point out by means of a review of the literature as well as by diagrams, the many different varieties of mobile cecum.

The syndrome is usually one of long standing right lower quadrant pain with acute exacerbations on-

accompanied by the usual clinical and laboratory findings which would ordinarily be interpreted as acute appendicitis. In many of these cases the condition is diagnosed as appendicitis only to have the symptoms recur after appendectomy. Aside from the chronic type of pain there are usually audible borborygmi in the right lower quadrant, and a tumor mass can often be palpated. Careful roentgenographic and fluoroscopic studies will usually reveal the type of mobile cecum that is present.

Despite the many varieties of mobile cecum and the many confusing names heretofore applied the author believes that all types should be called simply mobile cecum although the surgical approach to the various types need not be alike. The individualization as far as surgery is concerned will depend upon the pathology presenting itself. Procedures which have proved successful depending upon the type of lesion present, are fixation to the lateral peritoneum, resection of the redundant portion of the cecum or entire right colon, and various types of side-to-side anastomoses, in order to prevent stagnation in the enlarged cecum.

If the surgeon is aware of the various procedures which might be utilized he will then be able to adjust his surgical approach to the pathology presenting itself rather than be committed to a specific surgical procedure in each instance.

HAROLD LAUFMAN M.D.

**The Present Day Therapy of Thromboembolic (Streptococcal) Colitis.** J. ARNOLD BARON *Med Clin. N. America* 1943, 32 667

In the present article the author considers that form of ulcerative colitis which has its inception in the most distal portion of the rectum and spreads relentlessly orad from that point.

The author stated that treatment should rest on the convictions (1) that the condition is an infectious disease of the large intestine (2) that uncomplicated cases constitute a medical problem, and (3) that certain complications are definite indications for operation.

Medical management of the patient includes rest and restful recreation, a diet adjusted to the needs of each patient, vitamins, vaccine nursing care, drugs and antibiotics, oxygen, transfusions of blood, irrigations and instillations, removal of foci of infection and parenteral administration of fluids.

The decision whether an operation should be performed is a common problem in these cases. Certain late sequelae of the disease present definite surgical problems. The principal ones are polyps, neoplasms, strictures, extensive perianal fistulas, localized perforations and abscesses of one kind or another. Except for these and such essential operations as those for acute intercurrent surgical disease, surgical treatment should seldom be chosen. Ileostomy was found to be the procedure of choice.

When the disease has advanced so far that ileostomy is advisable, colectomy usually should be performed at a later date and as soon as the patient's

condition warrants. In most cases it is well to postpone colectomy at least 6 or 8 weeks after the ileostomy.

Medical management should proceed after ileostomy in the same manner as before the operation and if medical treatment is carried out carefully there will be a few cases in which colectomy will not be necessary and the ileac stoma can be closed with reasonable safety.

The patients without colons can live just as full and happy lives as those who have colons. No demonstrable physical deficiencies follow colectomy. It does not disturb the physiologic equilibrium of the body generally or of the chemical constituents of the blood except temporarily. The terminal portion of the ileum becomes demonstrably although not markedly dilated after colectomy. A general diet can be taken. Special care of the ileac stoma becomes minimal. Patients are able to resume their economic and social activities. The same advice and precautions about overdoing and prevention of nerve tension, given to the patient whose condition is controlled by medical means, apply to all patients who have had thromboembolic colitis. Occupations should be such that undue exposure to the elements and great expenditure of nervous energy are not needed and adequate physical and mental rest can be obtained.

There is analogy between the course of this disease and that of tuberculosis and every patient who has had a severe attack of ulcerative colitis is always a potential colitis patient. Relapses are common if the medical regimen is not followed assiduously. The most common causes of relapse are (1) infection of the upper part of the respiratory tract, (2) mental and physical trauma and (3) the lighting up of distant foci of infection.

**Colectomy in Ulcerative Colitis.** SIR HUGH DEVINE and JOHN DEVINE. *Brit. M. J.*, 1948, 2 187

The results of surgical treatment in 11 desperate cases of ulcerative colitis are reported. A stage procedure is described in which each successive step in treatment was designed not only to bring about improvement but also to be a stage in the removal of the colon. An enterostomy was so planned that it was a step in the formation of an ileorectostomy. About 5 weeks later the ileum was connected to the rectum by the use of a special spur-clamp and the open ends of the bowel taking part in the anastomosis were closed under local anesthesia. The colon now isolated with both ends forming two mucous fistulas was completely out of action and was treated by routine chemotherapy over a period of months until the patient ceased to improve. Since there was no discharging enterostomy and the patient was comparatively comfortable, this period could be prolonged indefinitely until the patient was fit for the last stage, namely, colectomy.

In another case the ascending colon showed no evidence of the disease and was preserved and used as an artificial anus while the remainder of the colon

and rectum were resected in stages. Subtotal colectomy was also of value through the removal of much of the diseased colon.

Of the 11 patients, 2 died. One patient died of an adynamic ileus immediately following the first stage modified enterostomy and one died 3 months after the first stage from tissue deficiency and toxemia. None of the patients died following colectomy or excision of the rectum. Six patients seem to be cured and the patient who had the worst case of all has been well for 6 years. They have no discomfort and lead normal lives.

Although the series is small it includes such severe cases and such good results that the authors have built a future surgical policy based upon their experience. They believe that a case of established ulcerative colitis should come to a surgical consultation early in its course to consider the question of early operation from the following viewpoints:

1. Can the surgeon help the physician? He may be able to do so by making a nonleaking valvular appendicostomy.

2. There is some justification for the removal of the appendix since it is not above suspicion as the point of entry of the infective element in the colitis.

3. To find out early in the course of the disease whether or not the ascending colon is free of the disease because in this case the prognosis is much brighter and early operation is justifiable.

4. To ascertain the type and severity of the disease with a view to planning its treatment.

The author believes that judgment as to whether medical treatment will cure or not can be made. More attention to tissue resistance and tissue repair is advised since they probably play a more important part in this infective disease than does the virulence of the organism. When ulceration and loss of substance of the mucosa have taken place and the physician is making no headway with his treatment, early operation with a view to removing the colon is advised. The reward of early colectomy or subtotal colectomy is a low immediate mortality and a good chance that the rectum will recover when the colon is removed. JOHN L. LUNDQUIST, M.D.

**Blastomycosis of the Anorectal Region.** Considerations on 2 Cases (Blastomycose da região anorectal. Considerações sobre dois casos). CARLOS DA SILVA LACAY and EDISON DE OLIVEIRA. *Hospital Rio*, 948, 33, 845.

South American blastomycosis improperly called Brazilian blastomycosis, rarely causes manifestations in the anorectal region. The lesions are usually localized in the buccopharynx, the lungs, the skin and the lymph nodes. The portal of entry for *Paracoccidioides brasiliensis*, the agent of the mycosis is generally at the buccopharyngeal or respiratory mucosa exceptionally at the skin. The authors report 2 cases with involvement of the anorectal region. In one of them the condition was probably due to the use of vegetal leaves to cleanse the region after defecation.

In the first case the lesions consisted of perianal ulcerations with elevated and papulous borders and a granular base covered by purulent secretion in which were found forms of the paracoccidioides. The rectal mucosa was hyperemic and bled easily. There were two small ulcerations in the middle portion of the rectum. The lungs were not involved. In the second case the only lesion was a small superficial ulcer of the rectum, with irregular contour and covered by purulent secretion. Biopsy revealed the presence of paracoccidioides. There was no pulmonary or other involvement. Both patients were treated successfully with sulfadiazine.

The anorectal localization of the disorder must occur more frequently than is generally believed. Only 2 cases have been described in the literature. The intestinal lesions are usually located in the cecocolic region and are of variable size with a granular base and may involve the serosa, with consequent inflammatory reactions and the formation of adhesions. The agent usually causes a granulomatous reaction of diffuse type that starts in the lymphatic follicles and Peyer's patches of the submucosa. A careful proctologic examination should be made in every case of South American blastomycosis because of possible rectal involvement.

*Paracoccidioides brasiliensis* is found on plants and in the soil. The frequent habit of the Brazilian mestizo to cleanse his anal region with vegetal leaves should lead to an increase of the anorectal forms of the blastomycosis. However there may be other etiopathogenic mechanisms for such lesions. They could occur through direct localization of the previously swallowed parasite or the parasite could reach the perirectal lymphatics through lymphatic dissemination of the process from some other part of the body. Other conditions may favor the localization of the agent in the rectal mucosa, as amebiasis and lesions caused by shigellosis. The diagnosis is not difficult. The parasite is easily found. It has a characteristic morphology especially in fresh specimens. In case of ulcer biopsy is advisable.

Sulfadiazine is the treatment of choice. A blood concentration of 5 to 10 mgm. per 100 cubic centimeters is sufficient to guarantee frank amelioration. The sulfonamide may be applied locally in the form of pulverization or nebulization. Polyvalent antimycotic vaccine therapy is recommended in addition to general medication to increase the organic resistance of the patient. Unfortunately there is as yet no proof of the cure of the disorder therefore a periodic follow-up is necessary for timely attention to possible recurrences. RICHARD KEMEL, M.D.

#### LIVER, GALL BLADDER, PANCREAS, AND SPLEEN

**Cancer of the Gall Bladder** (Cancer do la vesícula biliar) ARNALDO YODICE y EMILIO ETALA. *Da med.*, B. Air 948, no. 366.

This article is an analysis of 14 cases of cancer of the gall bladder. All except 2 of the patients had an

associated cholelithiasis and in 11 it was of the scar rhou type. The following symptoms predominated (1) pain in 62 per cent, (2) icterus in 69 per cent and (3) palpable tumor in 68 per cent.

Eight of the 14 patients showed calcification of the gall bladder on preoperative roentgen films and laparotomy was not only necessary to confirm the diagnosis of cancer but was of value for prognosis and metastatic studies.

Nine patients were considered inoperable. Three were treated with x-rays and one of these survived 4 years, the 2 others however lived only 7 and 8 months respectively. Of the 5 patients operated upon one lived 2 years and the others lived 15 years 9 months 5 months and 3 months respectively.

Because of the desolate outcome of the 14 cases described it is hoped that the observations given may help to alert others toward an earlier recognition of cancer of the gall bladder.

STEPHEN A. ZIEGLER, M.D.

**Considerations with Regard to a Case of Acinous Carcinoma of the Pancreas with Hypoglycemic Manifestations** (Consideraciones acerca de un caso de carcinoma acinoso de páncreas con manifestaciones hipoglucémicas anteriores). GUTIERREZ A. FROENK and EDUARDO F. LASCANO. *Arch. argent. enferm. op. digest.* 1947 22: 425.

Despite the difficulty of proof the authors attempt to show the causal relationship between carcinoma of the head of the pancreas and an associated hypoglycemia with the functional modifications of the central and vegetative nervous system, the liver, the hypophysis and the suprarenal and thyroid glands. It is contended that when such manifestations exist along with a presumed pancreatic affection resort to surgery is indicated with investigation of each element of the Whipple triad or of Wilder's postulates.

A case is reported of a 31 year old patient who, 7 years previously had had icterus and associated choledochal blockage. On present admission the patient was disoriented and confused, later collapsed into unconsciousness, developed convulsive seizures and was referred for neurologic studies. These proved unrevealing, but because gall bladder disease was found on physical examination a laparotomy was performed which revealed a palpable tumor of the pancreas. The tumor which proved to be an acinous carcinoma was removed without incident. The associated extraneous symptoms diminished progressively after removal of the tumor.

It was concluded that the carcinoma created the hypoglycemia, which, in turn, was responsible for the convulsions, facial paresis and the other neuro-vegetative symptoms. The deranged glycogenic metabolism accounted for the suprarenal insufficiency as well as the hypophyseal and thyroid complications.

STEPHEN A. ZIEGLER, M.D.

## MISCELLANEOUS

**The Infected Ovarian Teratoma as a Diagnostic Problem** (Ueber die infizierten Eierstockteratome als diagnostisches Problem). KEIJO SORVA. *Ann. chir. gyn. fenn.* 1948, 37: 80.

The author stresses the fact that infections in dermoid cysts of the ovary are quite rare. In Blackwell and Dockerty's series, infection was present in only 1 of 273 cases while in other series infection occurred in as high as 11 per cent. The author presents 4 personal cases. Three of these lesions were infected dermoid cysts and the fourth was an infected embryonal teratoma. The source of the infection in 2 of the cases was ascertainable: in one case infection followed vaginal aspiration of the cyst and in the second case infection followed typhoid fever. In the embryonal teratoma, the infection might have been ascribed to a puerperal sepsis.

In a review of the literature the author found that in most of the early cases of infected teratoma the infection was introduced by diagnostic or therapeutic aspiration. As this procedure has been discarded the number of infected cysts is also decreasing. A good many cases have been reported in which typhoid or paratyphoid bacteria have been recovered from the cysts. The author's case was such a one. Puerperal sepsis has also been repeatedly reported as a cause of the infection.

The diagnosis of infected cysts is not simple. Its clinical manifestations are almost indistinguishable from salpingitis, tubo-ovarian abscess and suppurative parametritis. The author believes, however, that in many instances the x-ray examination will be helpful. In almost 50 per cent of cases, teeth or bone can be visualized in the skiagram. These must be differentiated from intestinal content, calcified lymph glands, calculi in the urinary tract, and calcified uterine fibroids. They are less frequently observed in older patients which leads to the suggestion that the calcium may be reabsorbed. Further more the content of the typical dermoid cyst may cast a negative shadow. The only other intra-abdominal materials casting a negative shadow are gas in the bowel, cholesterol gall stones and retroperitoneal lipomas.

Some of the authors have called attention to the possibility of seeing lines which suggest the appearance of hair in the cyst. The author has, however, never observed this. In one case a salpingogram was made while a probe was placed in the vaginal sinus. This film gave a definite clue to the diagnosis.

The only clinical sign which may help in the diagnosis is that a palpable mass may be present which is independent of the uterus. This in the presence of the signs of infection may lead one to suspect the presence of an infected dermoid cyst. The only sure method of diagnosis is the exploratory laparotomy.

WILLIAM C. BECK, M.D.



# GYNECOLOGY

## UTERUS

Primary Dysplastic Involuting Myofibrosis of the Uterus (*Allofibrosi primitiva displastica involutiva dell' utero*) PAOLO FORNI. *Ri. Ital. ginec.*, 1948, 3: 55.

The author reports a case of primary dysplastic involving myofibrosis of the uterus in nulliparas (one 27 the other 33 years of age) whose menstruations had been abundant from their inception both patients had developed menorrhagia which caused severe anemia the uterus was uniformly enlarged and subtotal hysterectomy and bilateral adnexectomy were performed

Macroscopically the uterus, although enlarged had practically retained its original form and was markedly indurated. On section the myometrium had lost its normal aspect, but the mucosa seemed to be intact. The increase in volume was due to thickening of the muscular wall and dilatation of the uterine cavity. The myometrium presented an anemic aspect and was of a yellowish color, against which stood out a whitish network of glistening tracts having the appearance of tendinous fibers that grated on cutting. Microscopically there was a more or less marked hyperplasia of the muscular elements (in the first case) and of the fibrocytic elements (in the second case). Their increase seemed to run parallel the proportions of the two remaining the same all over the uterus. The vascular changes were only secondary and without peculiarities. There were no inflammatory processes, or remnants of such processes and no infiltrates.

From the histologic and histochemical characteristics of the proliferated tissue there was no question of cicatricial tissue but of a particular type of tissue which assumed simultaneously the aspect of muscle and of connective tissue and seemed to derive from a genotypically vitiated bud. In other words there seemed to be a missed or deviated maturation and differentiation of the primary mesodermal elements which should have produced the muscular elements of the uterine wall and therefore also a rapid degeneration of the newly formed muscular elements with formation of a myomesenchymal tissue which being more resistant, had determined the increase in volume and later the fibrosis of the uterus. The varying degrees of hyperplasia and of evolution of these elements could thus explain the varying aspects (myohyperplasia sclerosis etc.) which these so-called fibrotic or sclerotic uteri present histologically and also the absence of any signs of previous or actual inflammatory process. Consequently there is here an involuting dystrophic dysplasia of the muscular cells of the myometrium, the picture of which can be found in other lesions of the striated muscles as for instance in cases of congenital torticollis.

The various pathogenic factors advanced by some (particularly pregnancy the menopause, and menstruation, because of the circulatory disturbances which they produce in the myometrium) would thus simply play the role of adjuvant etiologic factors in the determination of the fibrous involution of the uterus. For these reasons the author calls the lesion a primary dysplastic, involuting myofibrosis, representing a well defined entity which may have some aspects in common with fibromyomatosis and, to a lesser degree with fibroma rather than with fibrosis or sclerosis, which terms should be reserved for results of metritic processes. RICHARD KIMMEL, M.D.

Technique of Radium Therapy for Cancer of the Uterine Cervix (Su la technique de la curietherapie des cancers du col de l' utero) EMILE WALLON. *Presse med.* 1948, No. 19: 244.

Successful results of radium therapy in cancer of the uterine cervix are largely dependent upon a most precise technique. Lacking this, apparently satisfactory immediate results may be followed by recurrence or serious complications. Failures may be attributable to inadequate dosage exclusively vaginal application, inadequate protection of adjacent tissues and organs or to a secondary radioresistance developing as a result of insufficient treatment. Failures have, however been reported in cases in which no obvious fault in technique could be demonstrated. In such cases, the distribution of radiation may have been interfered with because of difficulty in adjusting the apparatus at onset, or its subsequent displacement. Because of scattering of the rays, the dose received by the tissues may vary widely and some tissues may escape irradiation altogether.

A series of roentgenograms are presented to illustrate the cause of some failures. Thus in some patients with retroversion of the uterus there may be marked infiltration and retraction of the vagina, forcing the end of the tube toward the rectum. Since only a single tube can be inserted the radiation affects too limited an area to produce complete sterilization, and unless it is supplemented by radiotherapy parametrial recurrence may be expected.

Destruction of tissue may also lead to displacement of the radium containers with resulting irregular distribution of the rays. In some cases there is a tendency of the tube to slip out of the uterus, and unless a control roentgenogram is taken, the operator believing the apparatus to be in the correct position, might have delivered the usual dose with resulting rectal complications. The tube may also be displaced by the colpostat which leads to overdosage or inadequate dosage according to its location. Overdosage to one of the lateral cul-de-sacs owing to displacement of the apparatus may cause injury to the ureter. Without routine roentgenologic control, it is difficult to know whether the radium treatment has

been satisfactory. Errors detected by this method can be rectified as a rule but in some cases errors defy detection as, for instance, in cases of neoplastic fixation of organs in abnormal positions. However roentgenologic examination is useful also in these cases since by indicating areas insufficiently treated the latter can be reached by roentgen therapy.

Radiologic control will permit a more precise study of the exact cause of failure in certain fatal cases. Before concluding that a tumor is radiosensitive it is necessary to ascertain that the radium is properly placed.

EDITH SCHANCHER MOORE.

**Reticuloplasmosarcoma of the Uterine Cervix**  
(Sul reticuloplasmosarcoma del collo uterino)  
FRANCESCO SERBA. *Quad. clin. anat. gin.*, 1948 3 191

A 49 year old woman had been suffering for a year with a fetid leucorrhoea and of late had had severe pains in the lower abdomen. At the Cancer Institute of the Vittorio Emanuele Hospital in Catania, Italy, the cervix was observed to be markedly swollen and indurated and covered with reddish-gray easily bleeding vegetations. The Wassermann reaction was negative even following reactivation.

A biopsy was done and the histological examination of the specimen disclosed a mass made up of reticular tissue with a predominance of plasma cells, with a pronounced pyroninophilia (Pappenheim) of their protoplasm. Some of these cells were smaller and resembled blastocytes however these also were pyroninophilic and were classed as immature plasma cells or preplasmocytes. Some of the cellular elements of the reticular component were also quite large with at times two or more nuclei. All these elements showed a tendency to group themselves about the numerous blood vessels which however showed no indication of syphilitic changes. Many cells of all types exhibited mitotic figures.

It is believed that the tumor in this case was of a sarcomatous malignant character arising from the reticular tissues and exhibiting a tendency to develop by metaplasia into plasma cells. It is also thought to be the first tumor of its type in this location which has thus far been reported in the medical literature. The findings in this case confirm the author's belief that the plasmocytoma is often confused with chronic vegetative masses about the feminine genitalia which are of syphilitic or gonorrheal origin and that the true plasmocytoma is in itself very rare in this location.

JOHN W. BRANNAN, M.D.

#### ADNEAL AND PERIUTERINE CONDITIONS

**Microscopic Studies on Chocolate Cysts. A Contribution to the Etiology of Intraperitoneal Endometriosis** (Mikroskopische Studien an Schokoladenzysten. Ein Beitrag zur Ätiologie der intraperitonealen Endometriose) VOZOU, *Geburtsh. und Frauenh.*, 1947 7 48, 87

The etiology of chocolate cysts has been a controversial subject in the literature for many years.

Most authors adhere to the implantation theory. The fact that these cysts occur most frequently in the ovary supports this theory, small particles of endometrium tissue are carried back with the menstrual blood to the ovary when, for some reason or other the outflow through the cervix is impeded.

However, many authors have been unable to find endometrial tissue in histologic examinations of chocolate cysts. Experienced gynecologists like Philipp and Huber believe that in only 60 per cent of cases are these cysts caused by endometriosis and that in many cases they occur as the result of a primary hemorrhagic diathesis in the capillaries.

The author examined a series of 50 chocolate cysts histologically and was able to find endometrial tissue in every one of them. He believes therefore that implantation of displaced endometrium is the sole cause of chocolate cysts. He discusses the technical difficulties in finding the endometrial tissue especially in large cysts and believes that the wall of the cyst should be examined in fresh condition, immediately after the extirpation. The cysts are never entirely surrounded by a membrane and usually there is a defect at the posterior wall. It is in this area that endometrial tissue is most likely to be found.

The reaction of the endometrial tissue in the cysts to the ovarian hormones varies in the individual cases. If the tissue is walled off by ovarian stroma, muscle fibers or connective tissue it is not influenced by the hormonal cycle but remains in the proliferative stage. If, on the other hand the endometrium grows toward the cavity of the cyst, it shows the same cyclic changes as the endometrium of the uterus.

With regard to the etiology of external endometriosis the theory of Philipp and Huber is that all cases of chocolate cysts are due to endometriosis in the fallopian tubes. The author examined 27 patients with chocolate cysts in the free abdominal cavity at a loop of the ileum or at the appendix. In only 4 of these was he able to find endometrium in the tubes although the entire length of both tubes was carefully examined by serial cuts. He believes therefore that in most cases external endometriosis also is caused by uterine tissue which has been washed back with the menstrual flow.

WERNER M. SOLMITS, M.D.

**Thecoma of the Ovary and Carcinoma of the Endometrium** (Tecoma del ovario y carcinoma del endometrio) JUAN CARLOS ARUMADA, RODOLFO SAMAMARTINO and JUAN L. SARDI. *Obst. gin. lat. amer.*, 1948 6 34.

Three cases of thecoma of the ovary associated with carcinoma proliferation of the endometrium are presented. The query proposed is whether there is a direct causal relationship between the two conditions or they are coincident and coexistent findings. No positive position is taken however certain inferential conclusions are given such as the relative frequency of thecoma of the ovary and atypical

hyperplasia of the endometrium and the effects of thecoma of the ovary on the postmenopausal uterus.

In many instances the small size of a thecoma of the ovary may cause it to be overlooked during a gynecologic examination.

STEPHEN A. ZIEGLER, M.D.

### EXTERNAL GENITALIA

**Vaginal Autodepuration: Present Status of the Problem and Its Possible Developments: The Biologic Significance of Lysozyme in the Vaginal Secretions** (L'atodepurazione vaginale. Stato attuale del problema e suoi possibili sviluppi. Significato biologico del lisozima nell'umore vaginale) G. VACCARETTI. *Qued. d. n. det. gla.* 1943, 3: 73.

In the study of Fleming's lysozyme an attempt is made to develop a reliable method of estimating quantitatively the amount of lysozyme present in the various body secretions, excretions and fluids available to a gynecologist. The method used at present is a modification of that of Sherwood, Falco and DeBeer for the estimation of penicillin dosages. The use of inverted cylinders over a culture in agar as developed by the Oxford workers with penicillin, is rejected as too full of inaccuracies for quantitative work. At present the method used is based on the cutting of small holes in the surface of the agar plate and the insertion of the material to be tested in these small wells. The organism employed for these agar plate cultures has been the *Micrococcus lysodeikticus* which is extremely sensitive to the lytic agent.

With use of the author's method it has been determined that many of the body fluids and substances contain these lytic enzymes—enzymes in that they are not used up in the process of carrying out the lysis. They are present in greatest concentration in the human being and to a lesser degree in animals. Even certain plant constituents contain them. Most interesting is their presence in great quantities in the albumin of the egg. In the realm of gynecology and obstetrics they are found in the amniotic fluid, in the funicular blood, and in the vaginal secretions. It is this latter finding which the author tries to fit into the vast and complicated picture of vaginal depuration.

The lysozyme was found in all the secretions of the vagina. It was present in very high concentration in the protective cervical mucous plug and the amount became less in the lower regions of the vaginal tract, but even at the outlet it still showed considerable activity. In the vagina of the newborn infant, Fleming's lysozyme is already present in small amounts which increase notably by the fifth to the seventh postnatal day until in the adult, the amount normally reaches the level of 1,600 to 51,000 U.G. (units of lysozyme per gram of material). In the present study it was not affected by the state of the vaginal pH nor by the presence of other bacterial strains in the vagina. The titer always seemed to increase in the presence of inflammatory conditions in the cervix or vagina. During menstruation the

values usually dropped to 25, up to 75 U.G., except in one instance of exocervicitis in which the titer remained at 1,600 U.G. Following the menopause also the titer dropped but remained at a moderate level. During pregnancy the titer was high and remained at the usual level during the puerperium. In the dysfunctional menometrorrhagias the levels were low and in tumors of the portio and corpus also the amounts varied but they were always higher in the presence of inflammatory complications.

The characteristics of the lysozyme could be easily distinguished from those of the bacteriophages and from the lytic principles of Gengou, of Turro, and of Petterson. The presence of penicillin notation, the lytic action of associated bacteria on the *Micrococcus lysodeikticus*, and any antilysozymic activity as the explanation of lysozyme resistance in some of the associated organisms could be excluded.

From the author's own experiences and from his study of the literature he concludes that the lysozyme present in the vaginal secretions acts as a valid defense against the microbial increments in the lower levels of the genital tract of the normal, healthy human female.

JOHN W. BRIDGMAN, M.D.

**Vaginitis Emphysematosa.** FIERMAN, L. GARDNER. *Am. J. Obst.*, 1943, 56: 3.

Of such rarity is the condition variously known as vaginitis emphysematosa, colpohyperplasia cystica, and emphysematous colpitis that it might well be placed within the realm of medical curiosities. The author presents a case report of vaginitis emphysematosa, giving full microscopic and gross details of the condition.

The characteristic lesion is one of gas-filled cystoid cavities of the mucosa and submucosa of the vagina and cervix. The lesion usually involves both the upper vagina and the cervix, but occasionally is limited to one site or the other. Vaginitis emphysematosa is more often seen during pregnancy. The condition is productive of only mild (if any) symptoms. The point of greatest interest concerns its etiology and this remains obscure. Although several theories have been formulated as to its development, none seem acceptable to our present-day pathologists with their increased knowledge of causes and the pathogenesis of diseases. Some possible stages in the pathogenesis of vaginitis emphysematosa are suggested. Argument is presented to support the opinion that the gas within the lesions has an endogenous origin as opposed to an assumption that the gas is air.

JOHN R. WATTS, M.D.

**Abdominal Colpocystostomy for Complete Prolapse of the Vagina and Bladder.** PAUL F. FLETCHER. *Am. J. Obst.*, 1943, 56: 41.

The author submits the "rectus suspension principle of crossed-suspender support" as a dependable surgical procedure in the treatment of complete prolapse of the vagina and bladder following hysterectomy for patients in whom an abdominal operation is not contraindicated. The important factor in-

involved in complete prolapse of the vagina pertains to the complete eversion of the anterior vaginal wall and bladder. It is the correction of this condition with which the author is primarily concerned.

The technique and operative procedure are described in detail, and illustrated. The preparation and mobilization of the vagina and bladder are shown. The author utilizes the Moschowitz technique of closure of the cul-de-sac for the prevention or correction of a hernia of the posterior vaginal wall.

Mobilization and placement of fascial strips from the anterior rectus sheath are performed so that the strip is long enough to reach the nreterovesical junction on the opposite side when the bladder is distended.

The location of the point at which the strips cross each other is decidedly important, because this is the point at which the greatest amount of support to the bladder is rendered. It should be situated on the interior aspect of the bladder wall as close to the posterior border of the trigone as it is conveniently possible to get it. This is facilitated by taking the strips from the anterior sheaths of the fascia rather than from the medial borders. Although it causes the "crossed-suspender" effect to be rendered at a slightly wider angle, the point of greatest support to the bladder is more efficiently located.

Postoperative treatment is routine except that continuous bladder drainage is maintained for at least 6 days. When drainage is discontinued careful precautions must be taken to be sure that subsequent overdistention does not occur.

The operation was performed for the first time more than 7 years ago. A summary is given of a series of 7 cases in which this principle has been used for the treatment of complete prolapse of the vagina and bladder following hysterectomy.

JOHN R. WOLFE, M.D.

### MISCELLANEOUS

**The Restorative Operation Following Sterilization**  
(Die Wiederherstellungsoperation nach Sterilisation)  
H. SCHMIDT ELMENDORFF, *Geburtsh. & Frauenk.*  
1948, 8, 301

The authors group sterilization operations into three types: (1) the excision of varying portions of the fallopian tube; (2) burying the end of the tube in the abdominal cavity by enclosing it in a fold of peritoneum; and (3) removal of the entire tube. About half of their patients were sterilized by the burying of the tubal end in the abdominal cavity.

The authors have devised an operation to restore functional continuity of the tube and uterus which is essentially as follows:

The abdominal (proximal) end of the tube is freed and any stenotic portion is removed. Three 0.5 cm long equidistant, splitting incisions are made through the entire thickness of the tubal walls and a ureteral cannula is threaded through the lumen of the tube. Through an incision in the posterior wall of the uterus the cannula is introduced to lead the split end of the

tube up to the uterine cavity. The split ends are folded back on themselves and tacked to the serosa of the uterine incision. The catheter is led through the uterine cavity and vagina and fixed externally during the postoperative period. This technique tends to reduce cicatricial contracture and stenosis of the tube.

In order that this operation may be done the tube itself must be intact, there must be an adequate blood supply to the tube and operative compression must be avoided. The best results are obtained in patients who have not had previous infection of the pelvis.

Four of the 9 patients have later become pregnant.

In 10 of the patients in whom the tube has been removed or cannot be reconstructed the authors have made an ovarian implantation into the wall of the uterus. The results of this type of operation are not remarkable. Even if functional ovulation is restored as evidenced by regular menses rarely do fecundation and pregnancy ensue. This may possibly be due to the fact that the ovum does not have a protected course en route to the nidation site or it may be possible that the uterus changes postoperatively so that it becomes unsuitable for nidation. In the literature only 12 of 240 patients with an ovarian transplant into the uterine fundus have had successful results, and of these 4 or less than 1 per cent of the total have given birth to living children.

JANE C. MACMILLAN, M.D.

**Fundamental Operative Methods of Repair of Urinary Fistulas in Women** (Metodi operatori fondamentali di riparazione delle fistole urinarie nella donna)  
CARLO COLOMBO, *Urologia*, 1948, 15, 99

The vaginal route of repair of urinary fistulas may be employed in the majority of cases, while the employment of the combined extraperitoneal suprapubic and vaginal approach is recommended chiefly in presence of adhesions to the anterior pelvic arch. The transvesical route belongs to the domain of the urologist. In difficult cases, especially in patients who have previously undergone surgical interventions, a two-stage operation is recommended by the author: the first stage consisting of suprapubic cystostomy for derivation of the urine.

The author favors Schuchardt's incision because it facilitates access to the lesion.

In the postoperative treatment the importance of the retention catheter is stressed in addition to the use of sedatives for the purpose of immobilization of the patient during the first few postoperative days. Prophylactic use of urinary antiseptics and daily irrigations of the bladder with mild mercurial solutions are recommended by the author. Periodic examination of the operative regions are made starting on the third or fourth postoperative day. As a rule, the retention catheter is removed on the twelfth day.

In a case with complete destruction of the urethra an interposition of the uterus furnished good results.

JOSEPH K. NARAT, M.D.

# OBSTETRICS

## PREGNANCY AND ITS COMPLICATIONS

**Serum Beta-Glucuronidase Levels during the Toxemia of Pregnancy** LESTER D ODELL and DONALD F McDONALD *Am J Obst* 1943, 36 74.

The purposes of this report are (1) to emphasize the differentiation by serum beta-glucuronidase values of pre-eclampsia and hypertensive toxemia of pregnancy (2) to illustrate the use of beta-glucuronidase levels in detecting a potential pre-eclampsia (3) to point out that beta-glucuronidase values are apparently of no prognostic value (4) to report levels for convulsive toxemia of pregnancy (5) to illustrate examples of toxemia of pregnancy in which repeated serum levels of enzyme were obtained and to correlate these with the clinical course of the disease.

Although the upper range for normal pregnancy does not exceed 17.5 micrograms per cubic centimeter at term, with few exceptions serum beta-glucuronidase values were high during pre-eclampsia. In fact, a figure above 20 micrograms seemed diagnostic for this condition. In patients with hypertensive toxemia most levels were within the range for normal pregnancy. Several patients were observed as long as 5 months without an elevation of serum beta-glucuronidase.

The authors summarize 5 cases in which the patients had convulsions. The serum beta-glucuronidase levels were not elevated during all the cases of convulsive toxemia of pregnancy.

Forty five patients exhibiting an abnormal weight gain were selected at random after 28 weeks of pregnancy and from one to four serum beta-glucuronidase levels obtained at intervals of every 2, 3, or 5 weeks. Consistently higher values were found in patients developing pre-eclampsia.

From the results of this study it would seem that serum beta-glucuronidase levels could be used to differentiate pre-eclampsia from hypertensive toxemia, but of possible greater importance would be its use to delineate those patients with excessive weight gain who are destined to develop pre-eclampsia from those who are not. Serum beta-glucuronidase determinations, obtained at 3 week intervals, after 28 weeks gestation might warn the obstetrician previous to such an eventuality.

JOHN R. WOLFF M.D.

**The Effectiveness of Various Diuretic Agents in Causing Sodium Excretion in Pregnant Women.** WILLIS L. BROWN and J T BRADSHAW *Am J Obst.* 1943, 56

The concept that edema may be due to a disorder of sodium metabolism has gained popularity to the extent that the clinical management of toxemias of pregnancy now generally includes a reduction in sodium intake. Because of the interest in sodium and in the factors involved in augmenting its excre-

tion a series of studies was undertaken to investigate the effects of so-called diuretic agents on the fluid and sodium excretion in women with normal and toxemic pregnancies.

The authors found that diuretic agents vary in their ability to increase the excretion of water or sodium, or both. Some preparations which are popular as diuretics, such as urea and hypertonic dextrose, were shown to be ineffective in that they did not increase the output of urine.

There seems to be a slight increase in volume of urine and in sodium excretion, induced by adequate amounts of ammonium chloride. The continued administration of ammonium chloride over the second and third days, after an increased sodium excretion has been obtained is relatively ineffective.

Mercurial and xanthine diuretics cause a moderate increase in urinary volume and the most marked increase in total urinary sodium of any of the agents studied. This effect can be obtained with either the mercurials or aminophylline but, from the pharmacological point of view, there seems to be little advantage in combining the two as in the commercial compounds.

Three patients with moderately severe toxemia were studied with regard to both sodium and urinary excretion. While these studies are too few to be of any clinical value, it is of interest that apparently the toxemic patient handles water and sodium in a manner similar to the normal pregnant woman, and responds in a similar fashion to diuretic agents. The evidence available suggests that the mercurials and xanthines are worthy of clinical trial in the management of the toxemic patient.

The clinical management of toxemic patients generally includes a liberal use of sedatives, such as morphine. If observations of the antidiuretic effect of morphine are confirmed its use in patients with oliguria may need to be restricted.

JOHN R. WOLFF M.D.

**Acute Leukemia and Pregnancy (Leocemia apud y embarazo)** JULIO BARAN FRANCISCO A. VIANCA IMAZ, y JORGE ALBERTO FERNÁNDEZ. *Obst. gín. del sur* 1943, 6 145.

In reporting a case of acute leucemia and pregnancy the authors observed that this was the first instance of this disorder at the Maternity Institute Buenos Aires, in 150,000 admissions. Furthermore they were able to collect only 83 such cases in the world literature.

Their patient was a 24 year old Italian woman, para IV, who was in the fifth month of pregnancy when she suddenly became prostrate and complained of headache, chills fever vomiting enterorrhagia, and showed ulcerous necrotic lesions in the mouth. Clinical and laboratory studies established the diagnosis. The course of the disease was rapidly downgrade

despite interruption of the pregnancy the patient dying 2 5 months later

The authors bring out the necessity of differentiating between acute leucosis and leucemia the latter being malignant and irreversible When associated with pregnancy it has 100 per cent maternal and 60 per cent fetal mortality Interruption of the pregnancy apparently has little influence upon the course of the disease

STEPHEN A. ZUKMAN M.D

Pregnancy and Fibroma (*Grossesse et fibromes*) G. GERRARD and R. VOKAC. *Brussels méd.*, 1948, 25 765

Opinions as to the significance of fibroma in pregnancy vary widely some authors consider their presence a catastrophe and others believe that pregnancy is not seriously affected except in rare instances. Also statistics relating to the incidence of fibroma in pregnancy vary widely—from 1 case of fibroma in 1 000 pregnancies to 50 per cent of cases. The authors believe the incidence to be around 1 in 100 cases

Following a brief discussion of the pathological anatomy of fibroma the authors proceed to consider the effect of pregnancy on fibromas It is estimated that during pregnancy about 18 per cent of fibromas undergo red degeneration, an aseptic process with local hemolysis. Changes in size of the fibroma have been noted (usually hypertrophy which occurs chiefly in the interstitial fibromas during the first months of pregnancy) Attention has been drawn to a not infrequent regression of the tumor during pregnancy Also displacements of the tumor may occur the anterior myoma ascending more frequently than the posterior Torsion of the pedicle of the fibroma is less common and usually it is associated with axial torsion of the uterus. It is the sessile rather than the pedicled tumors that undergo torsion and usually before the fifth month. Finally a fibroma of some weight may cause a retroversion of the uterus which may lead to incarceration of the pregnant uterus.

As regards sterility it appears that the interstitial and, in particular, the submucosal fibromas are chiefly responsible As to relative sterility it must be stated that mechanical obstruction leading to abnormal implantations of the ovum renders expulsion of the fetus twice as frequent as in normal implantations because of death of the poorly implanted ovum compression by the tumor incarceration of the uterus or submucosal hemorrhage

The literature on the subject of fibroma as a cause of sterility is reviewed. A case is reported in detail in which, in spite of most unfavorable conditions imposed by the tumor conception took place with normal pregnancy and delivery at 8 months of a macerated hydrocephalus Fibroma is very rarely the cause of ectopic pregnancy It is especially low tumors that lead to abnormal placentation or mal presentation.

Labor especially is likely to be unfavorably affected by the presence of a fibroma. Multiple tumors may interfere with uterine contractions or even lead to

uterine inertia Most authorities agree that the site of the tumor is the determining factor in the obstruction of labor although Stoeckel insists that its size is the important factor Low fibroma, such as fibroma of the cervix or prolapsed subserosal fibroma, may render delivery impossible.

A case is reported of rupture of the uterus with expulsion of the fetus into the abdominal cavity in a case of fibroma of the inferior segment on the right lateral surface of the uterus The woman recovered following a subtotal hysterectomy Rupture of the uterus always results in death of the fetus and nearly always of the mother as well Severe hemorrhage is the rule except in cases in which the vessels are thrombosed. The rupture may be asymptomatic, as in the case mentioned During delivery the fibroma may be the cause of severe hemorrhage or it may interfere with normal detachment of the placenta.

During the puerperium one may encounter, besides the usually rapid atrophy of the tumor a large percentage of uterine infections aseptic degenerations or abundant hemorrhage These secondary hemorrhages are rare

At present most authorities agree that unless signs of complications develop it is preferable not to interfere surgically for fibroma during pregnancy Bonafos and Rouxel (1941) even reported a case of non intervention with favorable results in which the fibroma had become gangrenous during the course of pregnancy However surgical indications must be based on the parity and age of the patient as well as the size and number of the tumors. Some authors recommend routine myomectomy, others perform this operation whenever it is feasible They contend that hemorrhage can be avoided by careful technique and that the state of pregnancy facilitates excision of the tumor Delivery is nearly always normal in these myomectomized women and interruption of pregnancy is required in only 10 to 20 per cent of cases. The maternal mortality rate is only 2 per cent. Others advise against this operation.

At term, in the presence of complications all agree that surgical intervention is indicated. Some perform a cesarean section followed by hysterectomy

Since the advent of the sulfonamides and antibiotics, more conservative measures are perhaps justifiable Some authors perform a myomectomy

During labor intervention is not indicated unless the patient is suffering from intra-abdominal hemorrhage or the tumor presents an obstacle to normal presentation The first operation is always a cesarean section followed by myomectomy if the fibroma is subperitoneal or by hysterectomy if the tumor is interstitial or in case of multiple or voluminous tumors. Some surgeons always perform a hysterectomy believing that enucleation with the risk of infection and hemorrhage is too dangerous.

During the puerperium, hysterectomy is indicated for necrotic degeneration of the tumor and myomectomy for hemorrhage A case is reported of pregnancy complicated by a low fibroma, in which the pregnancy went to term, and a forceps delivery was

accomplished with excellent immediate results. A month later the patient was admitted to the hospital as an emergency case in a severely anemic condition owing to profuse hemorrhages. An intramural myoma the size of an orange was removed. The operation was followed by complete recovery. In this case the absence of hemorrhage during pregnancy with the sudden onset of hemorrhage one month after delivery was the point of interest.

EDITH SCHWARTZ MOORE.

## LABOR AND ITS COMPLICATIONS

Methods of Management and Results in Primary Uterine Inertia (Ueber die Behandlungsmöglichkeiten und Ergebnisse der primären Wehenschwäche: Inertia Uteri) VIIRJO TUURILA. *A. A. chir. gynæc. fenn.*, 245, 37, 137

The author relates his findings and conclusions in 790 cases of primary uterine inertia occurring during the period from 1935 to 1946 in the Second Women's Clinic at Helsinki. Over 60 per cent of the patients were between 20 and 30 years of age. Nearly 80 per cent were primigravidae and of these more than a third were elderly primigravidae, i.e. over 30 years old. Breech presentation occurred in 25 per cent of the patients studied. The average duration of labor was 50 hours, 3 minutes, but if calculated from the onset of regular pains it was 38 hours 5 minutes.

The membranes ruptured spontaneously in 406 cases. In 378 cases artificial rupture was performed and in 45 instances the records were not complete.

In 270 of the 406 cases in which spontaneous rupture occurred the author analyzed the effect on labor when rupture took place during the first or second stage of labor. In 203 of this group (75.5 per cent) labor improved. In those cases in which the uterine contractions did not increase after rupture of the membranes the average duration of labor was 57 hours and 33 minutes; the average duration of regular pains was 43 hours and 45 minutes; the average time from the onset of labor until rupture was 21 hours and 45 minutes; the average time from rupture until delivery of the child was 35 hours and 50 minutes. The corresponding averages for the cases in which labor was accelerated were 50 hours and 51 minutes, 38 hours and 30 minutes, 42 hours and 20 minutes and 12 hours and 31 minutes, respectively. It is thus evident that the salutary effect of spontaneous rupture of the membranes is most apt to be evident when it occurs late in labor.

When the membranes were ruptured by the obstetrician labor was accelerated in 26 of 38 cases (68.4 per cent). The time intervals in which labor was expedited were 47 hours and 37 minutes, 36 hours and 20 minutes, 41 hours and 5 minutes and 6 hours and 35 minutes respectively. When there was no acceleration the figures were 54 hours and 50 minutes, 40 hours and 58 minutes, 36 hours and 41 minutes, and 13 hours and 53 minutes respectively. Hence it is wise to postpone artificial rupture until late in labor.

Thymophyalin was employed in 114 cases, and in 95 cases (83.3 per cent) a favorable effect was noted. Various doses were administered, but an average total dose of 0.75 c.c. was found necessary for good results. There seemed to be little correlation between the time of administration and the shortening of labor. In 34 patients receiving thymophyalin operative delivery was later required because of uterine exhaustion.

Pituitrin was effective in all 9 patients in which it was utilized. Quinine aided labor in only 10 (44.4 per cent) of 41 patients in whom it was used.

Operative intervention (excluding episiotomy, artificial rupture of the membranes and manual extraction of a breech) was obligatory in 234 patients (30.4 per cent)—103 (31.9 per cent) of the 605 primigravidae and 41 (15 per cent) of the 261 multigravidae were delivered by operative means. Forceps deliveries of which nearly one-half were midforceps, cesarean section, and accouchement forcé, were the most frequent means of operative delivery.

Puerperal morbidity developed in 214 patients (27.8 per cent). The most frequent cause was a mild variety of endometritis. The highest per cent of morbidity in the deliveries accomplished by operative means followed forceps delivery (56 of 112 or 50 per cent).

Two mothers (0.26 per cent) and 33 children (4.3 per cent) did not survive. High forceps were so complicated with an infant mortality of 21.6 per cent.

The general prognosis of uterine inertia is not favorable, especially so far as the infant is concerned.

WARRICK R. LANG, M.D.

Cesarean Section in Detroit During 1945: A Comparison with 1925 and 1934. HAROLD C. MAX and R. S. SODALL. *Am. J. Obs.*, 1948, 56, 60.

In Detroit, during 1945, among every 37 births there was one cesarean section. In 1935 there was 1 cesarean section in every 217 deliveries, and in 1925, 1 in 167 deliveries. On the other hand the maternal mortality with cesarean section in the three series was 13 per cent in 1945, 4.4 per cent in 1930, and only 0.8 per cent in 1925. The fetal death rates for the same years were 11 per cent, 12.3 per cent, and 7.8 per cent. By 1945, low cervical section had become the operation most frequently employed since it had proved to have distinct maternal advantages over the classical operation. Cesarean hysterectomy and extraperitoneal section were performed in 4 cases without mortality.

A rise in hospital confinements during the 20 year period to more than 94 per cent of the deliveries in 1945 was accompanied by a reduction in the general maternal mortality to 1.6 per 1,000 live births.

In view of the markedly increased incidence of cesarean sections on the one hand and the greatly decreased mortality on the other the author believes it would be well to consider if too many operations of this type are now being done or if too few were done before. There is evidence that, in 1945, many sections were performed on slight indications, to say

the least. Apparently there is widespread disregard of the fact that although the death rate is low surgically speaking it represents a high immediate obstetric risk as well as a definite hazard in future pregnancies. On the other side of the question it is noteworthy that in 1945 at least 30 of the 58 maternal deaths were believed to have been preventable a number of them by timely cesarean section. Both sides of the question then seem to involve a proper regard for established indications and contraindications. Specifically pointing the way to further improvement is the fact that in at least 4 of the 8 cesarean deaths in 1945 the fatal outcome was due largely to faulty judgment or management.

The fetal mortality rate of 7.8 per cent in the 1945 cesarean sections though definitely better than in previous years, is still twice the over all death rate for infants during the first year of life. The fact that 36 per cent of the infants were stillborn again emphasizes the fact that cesarean section does not necessarily offer the best chance for a living child. Hence there is no justification for undue extension of the use of cesarean section for purely fetal indications.

JOHN R. WOLFE MD

#### MISCELLANEOUS

A Contribution to the Study of Conglutination of the Uterine Cervix (Contributo allo studio della conglutinazione del collo dell'utero) S. RIBONI *Fol gyna Genova*, 1948, 43 63

The cases of conglutination are here reported not only because of the peculiar circumstance that this rare condition (1 in 5,000 or 6,000 deliveries) occurred twice within a week's time but also because of the striking differences in pathology and in therapeutic indications. Conglutination at the external cervical orifice occurred in a 24 year old primipara who had always menstruated normally and nothing abnormal was noted during the pregnancy and even at the onset of labor. After the labor had been in action for 30 hours and the cervix was fully effaced it was noted that the cervical os was still closed and apparently occluded and obstructed by a whitish plug of a substance of greater firmness than the surrounding tissues. A moderate amount of pressure by the examiner's finger was sufficient to force the occlusion, whereupon the uterine orifice immediately spread apart with the appearance of the bag of waters. After a rather slow labor a living female child of 5500 gm. was extracted with the forceps.

The second patient, a 38 year old gravidula, had undergone a forceps delivery of a dead child. During the present pregnancy a flat pelvis (conjugata vera 9.2 cm.) was demonstrated but nothing abnormal was detected about the cervix. Here, as in the first delivery premature rupture of the membranes occurred and a subsequent fetal asphyxia forced immediate cesarean section. The child was eventually resuscitated however preservation of the uterus seemed indicated in this doubtful period to preserve the procreative power of the mother. The lower

portion of the amniotic sac about the internal cervical orifice was adherent to the uterine wall and the internal os itself seemed to be conglutinated. The operator's finger inside the uterus could be forced part way through the cervical canal and then a curved forceps was forced the rest of the way through into the vagina and the tract thus formed was dilated. Subsequently upon vaginal examination it was found that the forceps had deviated from the canal and forced a false passage behind the true cervical opening. The lip of the cervix was then grasped by a tenaculum and a straight forceps was forced along the true cervical canal which was thoroughly dilated. This opening was considered adequate for drainage, although there was a huge clot in the uterus resulting from a partially detached placenta. The contents of the uterus was foul. The patient had manifested a fever during the period of delivery. The peritoneal cavity was dusted with sulfonamide a sulfonamide-gauze drain was left in the uterine cavity, and the administration of penicillin was started. Recovery was uneventful.

The author believes that with the new surgical aids hysterectomy is no longer indicated in these cases of conglutination if adequate drainage can be assured through the cervix.

JOHN W. BRENNAN MD

Peritonization of the Lesser Pelvis with Vesical Peritoneum and Its Obstetrical Consequences (La peritonisation du petit bassin avec le péritoine vésical. Ses conséquences obstétricales) G. CORRI and J. MATHIEU *Rev fr gyna obst* 1948 43 32

In most conservative operations on the adnexa, the vesical peritoneum is left intact and can be used to cover the raw surfaces of the uterus and parametrium. In cases in which only the ovaries and uterus can be preserved and therefore with no possibility of pregnancy the uterus may be completely hooded by the flap which is sutured to the peritoneum to cover the uterine isthmus and uterosacral ligaments. If the base of the cul-de-sac of Douglas has likewise been denuded it too can be covered by excluding it with a suture of the vesical flap to the anterior surface of the rectum. To prevent fresh adhesions to the ovary it is always left above this level in a peritoneal cavity with normal walls. After experience with this intervention for 25 years the authors conclude that with this technique they can prevent the majority of failures attributed to conservative operations for adnexitis.

However in cases of only unilateral castration and of myomectomy the uterus cannot be brought into so accentuated an anterior position as attempted in the cases mentioned. Generally speaking it would seem wise not to pass beyond the utero-ovarian ligaments posteriorly. It is even suggested that the end of the vesical flap be sutured on the sides to this ligament which leaves the tube quite free. However if raw surfaces remain on the side from which the adnexa have been removed, these may be excluded by suture of the vesical peritoneum farther posteriorly



on this side. Possibly following cicatrization there may be some torsion of the uterus on its axis, which might be responsible for the obstetrical complications recently described as a result of this method by Gouget. Hitherto no such complications have been reported. During the past 3 or 4 years, however several cases of dystocia in patients previously subjected to vesical peritonization have been reported. In Gouget's series of 96 cases of pregnancy following vesical peritonization, 90 per cent of the patients were normal. The incidence of complications during pregnancy was no greater than in nonoperative cases. The incidence of abnormal presentations was, however 9 per cent as compared with 0.5 per cent in nonoperative cases. These were chiefly shoulder presentations. In such cases, labor does not begin normally and if it is not induced the fetus may even die in utero. Cesarean section is the only suitable procedure and should be done promptly to save the life of the infant. In operations performed on such patients it was frequently observed that the uterus was in a position of left or right torsion with the adnexa accordingly forward. The bladder most frequently had moved upward on the anterior surface of the uterus completely covering the inferior segment, so that hysterotomy was usually preferable to low cesarean section.

The authors have attempted to discover the mechanism responsible for these abnormal presentations. In 10 of the cases reviewed in which Gouget attributed obstetrical complications to vesical peritonization there were associated factors which would have to be considered. Thus in 2 cases there was a narrow flat pelvis, in 1 other cases, uteroparietal adhesions and in 1 case there was low insertion of the placenta any of these conditions might have contributed toward the abnormal presentation. It was also believed of interest, in attempting to evaluate the role of vesical peritonization in these complications, to ascertain the type of the previous gynecologic intervention. It was noted that although abnormal presentation occurred in 2 cases in which the Pesta-lozza peritonization had been done for correction of

retrodisplacement, in 20 other cases in which there had been no myoma or adnexitis the pregnancy and delivery were normal, including a case in which the peritoneal flap had been sutured in back of the uterosacral ligaments (with a subsequent normal pregnancy). In only 3 of 30 patients with peritonization following unilateral castration were there subsequent pregnancies with abnormal presentations. The incidence of the latter following myomectomies was slightly higher probably because of the uterine contraction. In patients who became pregnant after peritonization for extrauterine pregnancy and colometrosis of the isthmus deliveries were normal. Therefore, the incidence of abnormal presentation following the Pesta-lozza procedure is from 6 to 7 per cent.

The high incidence of shoulder presentations is attributed by the authors to faulty technique, namely to the fact that during peritonization the bladder has not been adequately liberated from the vesical peritoneum, which permits the bladder to rise, frequently half way up the pregnant uterus, as demonstrated by the adhesion of the bladder to the wall of the uterus. Bertrand and Roman have emphasized the importance of incising the small fibromuscular bundles which move the bladder to the peritoneum near its apex. With these divided it is possible to push the bladder completely behind the symphysis, and the peritoneal flap thus obtained is very thin and flexible and would in no way interfere with development of the pregnant uterus. Following myomectomy it is possible that the raw uterine surfaces at the site of the hysterotomy incisions form solid adhesions with an inadequately displaced bladder.

The authors conclude that in spite of these occasional obstetrical complications, vesical peritonization has too many advantages to be abandoned. It not only permits excellent end results in conservative surgery but a considerable number of pregnancies may be saved in patients operated on for myoma and adnexitis. An important factor in technique is the adequacy of retrodisplacement of the bladder.

LOUIS SCHRAMME MOORE.

# GENITOURINARY SURGERY

## ADRENAL, KIDNEY AND URETER

**A Case of Anuria Due to Mercury Bichloride Poisoning Cured by the Intravenous Injection of Novocain**  
(Un cas d'anurie due a l'intoxication par le sublimé, guérie par des injections de novocaïne intraveineuse)  
KARL UHLIR. *J. urol. med. Par.* 1948 54 48.

After a brief review of the pathology the author describes two clinical aspects of mercury bichloride poisoning: (1) the initial polyuria and albuminuria which results after a few hours in anuria (this concerns the mild cases in which diuresis is re-established and followed eventually by polyuria of several weeks' duration) and (2) the severe condition in which anuria occurs without preceding polyuria.

The general management consists of the administration of fluids, gastric lavage and the administration of an antidote if such exists.

The author had no opportunity to try BAL, British antilewisite.

In severe cases the medical treatment is without result. The same is true for decapsulation or nephrostomy performed in order to promote kidney function. Also splanchnic or lumbar sympathetic block with novocain has been without result, although efficient in other cases of anuria. The intravenous injection of novocain recommended by French authors has brought good results in anuria caused by bilateral kidney calculus, sulfanilamide or chronic nephritis.

The author describes the case of a 47 year old patient who in a suicidal attempt took 12 gm. of mercury bichloride. The routine medical treatment was without result and the patient was anuric with advancing azotemia for 5 days. The author injected from 10 to 15 c.c. of 1 per cent novocain solution twice a day intravenously from the fifth to the eighth day and 15 c.c. of this solution once a day from the ninth to the sixteenth day. The urinary output started 3 hours after the first injection with albuminuria and casts. After 24 hours it was 75 c.c. and it gradually increased within the following 6 days to 1600 c.c. per day at the end of the twelfth day after onset of the condition. From then on the range of output was between 1500 and 3500 c.c. per day. The blood chemistry became normal and at the end of 2 months the urine was free from albumin and normal kidney function was present.

ERNEST BORG, M.D.

**A Contribution to the Production of Experimental Nephritic Lesions. Nephrosclerosis Produced by Cellophane** (Contributo alla produzione di lesioni nefritiche sperimentali. La nefrosclerosi da cellophane)  
ROBERTO CACCIU. *Arch. Ital. urol.* 1947 23 217.

In 18 dogs experimental nephritic lesions were produced by wrapping their kidneys in cellophane ac-

cording to Page's method. The transperitoneal approach was used and first one kidney and 20 days later the other was surrounded by cellophane. In this manner perirenal as well as parenchymal lesions were produced. Changes in the interstitial tissues, glomerular tubules and blood vessels were thus provoked. The relatively chronic changes greatly resembled those in human nephrosclerosis. The histologic changes were analogous to those in chronic interstitial nephritis. Angiographic examinations of the vascular network supplemented the histologic studies.

The author concludes from his investigations that the use of cellophane for wrapping the kidneys merits especial attention among the various methods of producing experimental nephritis, because the characteristic complex of such lesions may thus be provoked and because the relative chronicity of the evolution of the process allows the utilization of experimental animals for scientific studies. No other experimental method is capable of producing such intensive perinephritic changes as well as perinephritic changes as those created with cellophane. JOSEPH K. NARAY, M.D.

**Injury of the Ureter from Gunshot Wounds.** CARR F. ROBERT. *J. Urol. Balt.* 1948 60 65.

Because of inadequate facilities during World War I injury to the genitourinary tract was accompanied by a high mortality rate since few patients lived to reach a base hospital. However in World War II conservative surgery and early and adequate diversion of both the urinary and fecal streams proved to be the foremost factors leading to good results. Of equal importance was the administration of chemotherapy with the onset of injury and the rapid transporting of casualties to rear hospitals.

Because of the predominance of penetrating wounds which are the most likely to occur in war ureteral injury is frequently overlooked, especially in the stress of emergency work. Furthermore, injuries to important structures intimately related to the ureter are often so severe as to completely mask evidence of ureteral damage and often death occurs so rapidly that ureteral injury is not discovered.

The pelvic ureter is more frequently injured in gunshot wounds because it is not so well protected as the remaining portion and is more fixed than the latter which is small, elastic, and often associated with the extensive visceral injuries. Complete division of the ureter is more common than partial severance and early diagnosis is imperative to conserve renal tissue and obtain the best functional results.

In the greater number of cases pyelography is the only means of making a diagnosis. Urinary fistula is the characteristic symptom of unrecognized ureteral injury occasionally it is transitory the leak arising

from a partial rupture small enough to heal spontaneously and often followed by ureteral stricture.

Extravasation of urine arising from the ureter even without free drainage, is far less severe than that from the bladder or urethra. When the ureter has been severed and the tissues have obliterated the trace of the bullet, extravasation of urine forms a mass in the adjacent region with sepsis.

The first consideration in treatment is relief of shock. The manner of treating the ureteral injury depends on the location, extent of the injury and the time at which the lesion is discovered.

In partial rupture of the ureter, extraperitoneal drainage and insertion of an indwelling ureteral catheter with or without suture often are adequate. When complete division of the ureter exists, end-to-end anastomosis over a ureteral catheter with diversion of the urine, is the procedure of choice.

Occasionally, the ureter can be implanted into the bladder when the pelvic ureter is injured. There are very few cases in which ureterointestinal anastomosis is possible. When the condition is recognized early nephrectomy is the standard method of treatment for a fistula of the abdominal ureter. In late recognition of the presence of a urinary fistula and renal infection nephrectomy is the method of choice.

JOHN A. LOYR, M.D.

**Carcinoma of the Ureter.** THOMAS GUALTIERI, JAMES J. HAYES, and ABRAHAM D. SEGAL. *J. Urol. Balt.*, 94:5, 59, 1935.

TWO cases of primary carcinomas of the ureter are presented, one with early changes and the other long-standing, with late changes including perforation and a perinephric abscess. In both cases, filling defects in the ureters were noted on pyeloureterograms and an efflux of bloody material was noted when the catheters entered the lower ureters. In the early case the return through the catheter became clear upon reaching the renal pelvis.

The similarity of the malignant lesions of the conduit system of the urinary tract is noted, and the pathogenesis is discussed.

We believe that future investigation of this problem must concern itself with the effects of the various methods of therapy at hand as also those yet to come that the goal must be prevention or failing this, a reversal of the abnormal process with the object of obtaining an absolute cure.

Perhaps the answer may be found in the hormones, enzymes and their attendant biochemistry in x-rays and radium, in galvanism and iontophoresis, or even in the domain of the atom, when and if man finds his way around to controlled atom fission therapy.

JOHN A. LOYR, M.D.

**Indications and Immediate and Remote Results of Ureteroaligmoidostomy (Indicazioni e risultati immediati e remoti della ureteroaligmoidostomia).** GIORDANO NICOLINI. *Urologia*, 94:5, 151, 1935.

The following indications for the operation of ureteroaligmoidostomy are cited by the author. In veter-

ate obstinate tuberculous cystitis, extrophy of the bladder, carcinoma of the bladder and cancer of the prostatic gland with intensive cystitis.

The first method by Coffey is preferred by the author to other modifications of the operation.

As to the immediate results, all 5 patients with tuberculous cystitis recovered, one patient with grave cystitis resulting from a cancer of the prostatic gland also recovered, of 3 patients with an extrophy of the bladder one died and one recovered and of 14 patients with a cancer of the bladder 8 recovered and 6 died.

One patient with extrophy of the bladder succumbed to paralytic ileus. Three patients with cancer of the bladder died from pyelonephritis, one from peritonitis, one from paralytic ileus, and one from pneumonia. The total immediate postoperative mortality in 23 cases was 33 per cent. Of the patients with benign lesions, 14 per cent and of those with malignant conditions of the bladder or the prostatic gland, 40 per cent died as the result of the operation.

A detailed analysis of the remote results convinced the author that ureteroaligmoidostomy represents the method of choice in the treatment of grave forms of tuberculous cystitis. In extrophy of the bladder compatible with life this procedure or the Maydl operation may be performed. Good palliation may be obtained in malignant lesions.

As to immediate postoperative fatalities, paralytic ileus develops in direct relationship to the duration of the operation while peritonitis and pyelonephritis are consequences of the necrosis of the isolated ureteral segment.

All patients had perfect continence and were evacuating urine at regular intervals of several hours. The tolerance was better in women than men.

JOSEPH K. NARAT, M.D.

**Experimental Contribution to the Implantation of the Ureters Into the Rectum according to Bergenhem's Technique.** (Contributo sperimentale all'implanto degli ureteri nel retto con la tecnica di Bergenhem) VINCENZO LAURICELLA. *Arch. Ital. Sci.*, 94:7, 2, 245.

Unilateral or bilateral implantation of the ureters into the rectum according to Bergenhem's technique avoids numerous disadvantages accompanying other operative methods. A perfect anatomic union of the implanted ureters with the rectum can be observed after the operation. The resulting ureteroenterostoma possesses a valvular mechanism which prevents an enteroureteral reflux. The newly created stoma shows no tendency toward the formation of a stenosis. Furthermore, the application of the aforementioned method creates conditions more physiological than those following other operative procedures.

The following indications are enumerated by the author: extrophy of the bladder, selected cases of cancer of the bladder, tuberculous of the bladder with involvement of one kidney, tuberculous of the prostatic gland and seminal vesicles, incurable vesicovaginal fistula, cases in which great difficulties are

encountered in reimplantation for uterine cancer, and selected cases of painful contracted infected and ulcerated bladder.

The method consists of the formation of a rosette from the vesical mucosa around the severed end of the ureters and implantation of the ureters into but tonholes in the rectum.

The author's conclusions are based on the experiments on 5 dogs. In 3 a unilateral and in 2 a bilateral, implantation of ureters was performed.

JOSEPH K. NARAT M.D.

# BLADDER, URETHRA, AND PENIS

**The Repercussion of Vesical Neck Dyssectasia on the Urinary Tract Above the Lesion** (Du retentissement des dyssectasies cervicales sur les voies urinaires sus-jacentes). JEAN BAUCHART and JEAN GARNIER. *J. urol. méd.*, Par. 1948, 54, 16.

The authors studied the effects of dyssectasia of the vesical neck on the urinary tract. He divided the cases into three groups. First he considered lesions of the neck: (1) anatomical lesions with sclerosis and (2) functional contractions due to hypertonicity on a nervous basis. A differentiation between the functional and organic types is frequently impossible and eventually sclerosis will be present in both.

The second type of cases presented a hypertrophic prostate gland due to adenoma and the third type of cases presented prostatitis.

Trabeculation and cellulitis were found upon cystoscopy and cystorontgenography revealed irregular walls with holes and studded with raised areas. There was residual urine. Of greatest importance however were the disturbances of kidney function.

Among the many renal function tests the authors consider intravenous urography as the most conclusive.

When the patient presents a contracted bladder neck dysuria is rarely absent. A residue is usually present when the patient consults his physician. It is constant and progressive. Cystoscopy reveals cellulitis and trabeculation and the residue varies from 100 to 150 c.c. Kidney function is initially good. Sounding and irrigations might relieve the condition temporarily but eventually resection which brings cure is necessary.

The initial stage is short. The residue increases quickly to from 200 and 300 c.c. with consequent bladder infection, the formation of a diverticulum, vesicoureteral reflux, kidney damage, uremia and pyelonephritis.

An infected residual urine was present in 55 of 65 cases. A bladder diverticulum and a reflux were present in 25 of 65 cases. Approximately 38 per cent of the patients have a reflux, a diverticulum or both. The diverticulum is considered to be acquired and not congenital. Azotemia was present in approximately 30 per cent and is less frequent in patients with a diverticulum. It is concluded that the diverticulum functions like a safety valve. A parallel be-

tween the residue and azotemia could not be established. Intravenous urography has proved to be a superior method which detects kidney damage earlier than determination of the blood chemistry. In 16 cases the blood chemistry and the intravenous urogram concurred. In 5 cases the superiority of the intravenous urography over determination of the blood urea, Ambard's constant, and phenolsulfonphthalein value could be demonstrated.

The renal infection pyelonephritis, is thought to be hematogenous. The kidney infection remains in conspicuous with vague lumbar pain, digestive discomfort, dryness of the tongue and polyuria. In rare cases, an acute pyelonephritis might develop.

When the patient has an adenoma of the prostate gland residual urine and dysuria are also present but their appearance is different. Cases of acute complete retention are frequent as compared with cases of contracted vesical neck. Among 280 patients, 149 revealed acute retention and 131 no retention. Characteristic of the acute retention in adenoma is its reversibility by simple catheterisation with complete loss of the residual urine. It is rarely caused by a middle lobe. Eleven of 14 patients with an enlarged middle lobe had no acute retention at any time.

Dysuria is less marked. It was absent in 78 patients slight or temporary in 165, marked in 34 and unknown in 3. In comparing cases of acute retention with those without retention dysuria was absent in 59 against 19, was slight or temporary in 86 against 79, was marked in 3 against 31 and was unknown in 1 against 2.

The residual urine in 23 per cent of 90 cases with out acute retention ranged from 0 to 100 c.c. In contradistinction in cases with acute retention it ranged from 0 to 100 c.c. in almost 77 per cent. The detrusor muscle is capable of regaining its strength in cases with acute retention once this has been relieved.

Two groups are differentiated: (1) cases with acute retention with slight or absent dysuria and a low residue of urine, and (2) cases without acute retention, with frequent dysuria and a marked degree of residual urine. The explanation is thought to be the invasion of the smooth internal sphincter by the adenoma in the second group. In the first group, the internal sphincter remains undamaged for a long period.

This determines the indication for intervention. In cases with a low residue of urine but persisting dysuria intervention should be advised a patient with no dysuria should be regularly supervised in order to intervene in time.

Bladder infection is frequent—less than one-fifth of the cases had a clear urine without infection. Some cases with a high residue remained uninfected. Bladder diverticulum and ureteral reflux are infrequent. Diverticula were observed in 8 of 280 cases of adenoma, whereas they were seen in 21 of 66 cases with contracted vesical neck.

Only 1 case of reflux was seen as compared with 9 in the group with contracted vesical neck. Renal

function is less impaired in cases of adenoma than in cases with contracted vesical neck.

In 33 per cent of the 131 cases without acute retention, blood chemistry revealed damage to kidney function. Among them was the case with reflux and all but 1 case of diverticulum. The diverticulum seems to play the same role as in cases of contracted vesical neck. Kidney damage in cases without acute retention is about the same as in the cases of contracted vesical neck. The cause is again thought to be the involvement of the internal smooth sphincter. A relationship between the blood chemistry and residual urine revealed that the blood chemistry remains normal with a residue below 100 c.c., and that only in one-half of the cases with a residue above 300 c.c. the blood chemistry is elevated.

Among 140 cases with acute retention 24 per cent revealed damaged renal function upon determination of the blood chemistry. This was almost 30 per cent less than of those in which there was no retention. Only 6 patients had a severely damaged kidney function as demonstrated by blood chemistry determinations (4%). The renal damage was frequently slight and temporary with a rapid return of the blood chemistry to normal. This was demonstrated with the urea Ambard's constant, and phenolsulfonphthalein tests during acute retention and after the retention had ceased. Renal damage appeared later, was less important, and was frequently reversible. This was contrary to the findings in cases of contracted vesical neck. The lack of invasion of the smooth internal sphincter was the cause of the clinical picture. Repeated acute retention was of no greater consequence for the kidney function than a single instance of acute retention. A comparison of the blood chemistry determination with the intravenous urogram revealed that in cases presenting no acute retention the findings were parallel in 23 cases; the superiority of the intravenous urogram over the blood chemistry determination of blood urea, phenolsulfonphthalein, and Ambard's constant was demonstrated in 5 cases. In cases of acute retention the results of the blood chemistry determinations and of intravenous urography were parallel in 19 cases and in 3 cases the urogram gave better information than the blood chemistry determinations.

The phenolsulfonphthalein test and Ambard's constant test were more sensitive than the blood urea test.

The authors conclude that in a number of cases (the very good and the very poor) the laboratory findings and the intravenous urograms are of equal value. In borderline cases the blood chemistry tests give inadequate information. The Ambard's constant and the phenolsulfonphthalein tests give more information, but the intravenous urogram is superior to all. This is important for the indication for intervention.

In the cases of prostatitis the following forms are distinguished: a sclerosing form and a hypertrophic diverticular form. Occasionally the latter is superimposed on an adenoma presenting an adenomitis.

Forty cases were studied. Thirty-two cases were examined by cystoscopy and 15 sclerotic and 17 hypertrophic cases were found.

Acute retention might occur during an acute flare-up and was observed in 5 cases (1 sclerotic form, 3 hypertrophic forms, and 1 adenomitis). Diverticula are not rare, being found 6 times among 40 cases. Diverticula are rarer than in cases of contracted vesical neck but more frequent than in cases of prostatic hypertrophy. No ureteral reflux was seen. Blood chemistry determinations revealed kidney damage in 35 per cent of the cases. The intravenous urogram disclosed kidney damage in cases in which the blood chemistry determinations did not indicate it.

Prostatitis with ureteral encroachment might rapidly lead to kidney damage. The repercussions caused by prostatitis are in between those caused by the adenoma and the contracted vesical neck.

Cancer of the prostate, especially the scirrhous, develops like a contracted vesical neck. The slow growth might delay the impairment of the renal function. A proliferating epithelioma causes even less dysetasia than a scirrhous.

Cancer of the prostate is not always characterized by cervical dysetasia. It might develop silently without urinary symptoms and become manifested by metastases.

Summary. In a contracted vesical neck, dysuria is the main symptom. It remains constant and the detrusor muscle develops diverticula in its fight against the obstacle.

Adenoma without acute retention, found in somewhat less than 50 per cent of the cases, limits the picture of a contracted vesical neck. It is less progressive and ends with distention and later kidney damage. In cases of adenoma with acute urinary retention the residual urine remains low and kidney damage is delayed because invasion of the internal sphincter does not occur. Temporary kidney damage during acute retention is reversible. The repercussion from prostatitis occupies a place between that of the two aforementioned conditions.

EASTON BORG, M.D.

## GENITAL ORGANS

**Hydronephrosis in Prostatic Obstruction.** HENRIK L. KJELLBERG and FAY H. SQUIRE. *J. Urol., Balt.*, 1937, 60.

The routine use of intravenous urography in prostatic obstruction has become an established procedure on the authors' service at the Presbyterian Hospital, in Chicago. A review of 408 intravenous urograms made during the period from 1933 to 1937 and from 1945 to 1947 was undertaken and the cases were divided into two groups designated as A and "B".

In group A the average duration of symptoms before medical aid was sought was 60.5 months and in group B 43 months, a differential of nearly 1 1/2 years. In group A there were 80 cases of hydrone-

phrosis an incidence of 44.44 per cent in group B there were 75 cases in which hydronephrotic changes were observed an incidence of 33.43 per cent.

For purposes of designating the degree of hydronephrosis the cases were graded on a basis of 1 plus to 3 plus. The evidence indicated little difference in degree of hydronephrosis in the two groups. Of the patients with carcinoma of the prostate 66.66 per cent of those in group A and 41.66 per cent of those in group B had hydronephrosis.

The authors conclude that hydronephrosis occurs more frequently in patients with malignant obstruction than in those with benign obstruction, and that it is in direct relationship with the duration of the disease in both cases. JOSEPH E. MAURER, M.D.

Primary Carcinoma of the Seminal Vesicle. E. M. GAZZ. *Brit J Urol* 1948, 20: 72

The author records 2 cases of this rarely diagnosed tumor from the Toronto General Hospital Toronto Canada during a period of 40 years. A review of the literature shows only 31 previously recorded cases of primary carcinoma of the seminal vesicle. The case of Labbe in 1883 is generally accepted as being the first case described.

In many cases the diagnosis was not made during life. In others the diagnosis was suspected only when the clinical picture was well advanced with retention of urine, hematuria, dysuria and loss of weight as prominent symptoms. Cystoscopy usually showed signs suggestive of obstruction and secondary tumor invasion. Rectal examination has frequently disclosed a hard nodular or irregular fixed mass above or in the region of the prostate. At autopsy metastases were widespread chiefly to the lungs, liver, lymph glands and mesentery.

In Case 1 the patient was a totally asymptomatic 65 year old man who in 1932 during the course of

a routine health examination was found to have a hardening over the right lobe of the prostate. Various examiners over a 2 year period entertained the diagnosis of carcinoma of the prostate and seminal vesicle or prostatic calculi the latter being the favored impression. In 1934 the patient developed hematuria and back pain. Roentgen examination revealed destructive vertebral and rib lesions. The patient died within a few months following the sequence of cystitis, pyelonephritis and uremia. At autopsy primary carcinoma of the seminal vesicles was found histologically forming columns of small vesicular cells. There was no invasion of the prostate but the tumor growth involved the bladder wall about the ureters.

Case 2 was that of a 36 year old patient who in December 1946 complained of lower abdominal pain radiating to the external genitalia. Treatment for seminal vesiculitis was unavailing and the patient had a weight loss of 25 pounds in a few months. In April 1947 a firm nodular mass 3 inches in length above the prostate on the left was considered tuberculous. There was a rapid downhill course following laparotomy in June 1947 at which time there was considerable fluid in the abdomen and biopsy sections of the hard mass above the prostate revealed a highly anaplastic tumor consisting of large polyhedral hyperchromatic cells. The patient died but an autopsy was not performed.

In the second case the tumor was obviously inoperable when first seen. The report of the first case however is instructive in emphasizing a well established urological dictum. Even in the absence of symptoms when a small suspicious mass in the prostate or vesicle is found consideration should be given to exposure through the perineum and examination by frozen section, with a view to radical treatment if it is cancerous.

ALLAN E. SWERDLOFF

# SURGERY OF THE BONES, JOINTS, MUSCLES, TENDONS

## CONDITIONS OF THE BONES, JOINTS, MUSCLES, TENDONS, ETC.

Evolution and Cause of Juengling's Disease (Evoluzione ed etiologia della malattia di Juengling) O  
OSERLINSON. *Chir. org. modern* 1943, 31: 50.

The author presents a supplementary report of a case of Juengling's disease reported by him 7 years previously. The symptoms occurring in this condition are known as the Besnier Boeck-Schaumann syndrome (benign lymphogranulomatosis, benign diffuse reticuloendotheliosis) which in the skeletal system forms the disease of Juengling (cystoid osteitis tuberculoidea multiplex).

Comparative films taken in 1940 and 1947 are shown of the shoulder girdle and the feet. There has been definite improvement of the cystic areas in the intervening 7 years.

The patient whose case is reported was employed as a housemaid and presented herself after an interval of 7 years because of increased osteoarthritic manifestations of the shoulders and hips.

The author explains that the condition is seen only rarely in Italy. In conclusion he stresses the following points:

The clinical condition is a definite entity in the skeletal system.

In spite of the fact that the condition is considered benign as far as healing of the cystic areas is concerned, the associated osteoarthritic condition is progressive.  
CARLO SCUDERI, M.D.

Muscular Torticollis. FREEMONT A. CHANDLER. *J. Bone Surg.* 1943, 30-A: 366.

This article is based upon a study of 235 patients with muscular torticollis (101 of these cases had been previously reported).

The accepted theories and the literature on this subject are quoted and it appears that most writers have agreed that the tumors of the sternomastoid muscle are hematomas caused by tearing of the muscle during birth, often in breech presentations. The author believes that malposition in utero with possible pressure and ischemia of the sternomastoid may render the muscle atrophic, maldeveloped, fibrous and shortened and therefore liable to damage during delivery.

The treatment advised in older children is detachment of the sternal and clavicular heads of the sternomastoid muscle, followed by retention in an overcorrected position. In the infants (43 infants under 1 year are included in this series) even when only a few weeks old the author believes excision of the fibrous tumor followed by the application of a light plaster splint to maintain the overcorrection for 3 to 4 weeks is justified. The operation is not difficult, but the spinal accessory nerve must be protected and disengaged from the tumor.

Microscopic section of the tumor which is white and fibrocartilaginous, shows abundant fibrous replacement of degenerating muscle fibers, and no evidence of hematoma at all, even in very young infants. There was no blood clot or residual blood pigment observed.  
NEWTON C. MEAD, M.D.

Coxa Plana. M. BECKETT HOWARTH. *J. Bone Surg.* 1943, 30-A: 601.

The author reports on 115 cases of coxa plana seen at the New York Orthopaedic Hospital between 1935 and 1944.

Coxa plana is a self-limited disease of the hip, of unknown etiology usually occurring between the ages of 4 and 10 years. The name is not altogether satisfactory but is the best so far suggested. The author believes that the term "aseptic necrosis" is not accurate and should be discarded. It is one of a group of diseases the osteochondroses, which include slipping of the upper femoral epiphysis, coxa magna, Osgood-Schlatter's disease, spophysitis of the calcaneus, and Koebler's, Freiberg's, Kleinbock's and Schroermann's diseases. They are all characterized by degenerative changes due to circulatory disturbance, but occur at various ages and in various epiphyses or small bones.

Eighty-five per cent of the cases encountered occurred in boys, and 90 per cent were unilateral. Either hip may be affected. The physical type of the child appears to have no relation to the disease, and an occasional patient presented a definite endocrine disturbance. Coxa plana may occur during the course of treatment of congenital dislocation of the hip in about 25 per cent of the hips, as a result of immobilization in a position of tension, particularly extension, abduction, and internal rotation. This position "wings out" the blood vessels and interferes with the circulation resulting in degenerative changes.

Pathologically there is swelling, edema, and hyperemia of the soft tissues, capsule, periosteum, and, especially of the synovial membrane. Microscopically there is edema, hypervascularity and thickening of the synovial membrane often with villous formation. Perivascular lymphocytic and plasma cell infiltration is usual.

The disease may be divided into four stages: (1) the early or incipient stage, in which there are only soft tissue changes and mild symptoms and signs associated with synovitis; (2) the degenerative or active stage, lasting 1 or 2 years, in which degeneration in the head and softening at the epiphyseal disc occur; (3) the healing stage, lasting 3 or 4 years, in which the dense areas are replaced by granulation tissue and finally by normal bone; and (4) the residual stage, in which only the deformity with its consequent symptoms remains. In each stage the soft tissue changes precede the bone changes.

In the early stage, the most common symptom is a slight limp, which increases with the intensity of the disease. Pain is rarely severe enough to prevent walking often it is only a mild ache or stiffness. It is relieved by rest, aggravated by activity or injury and referred to the groin, medial aspect of the thigh, or knee, following the distribution of the obturator nerve. The acute symptoms gradually subside and are replaced by symptoms due to faulty mechanics associated with the deformity. Eventually the symptoms of osteoarthritis may supervene. The earliest and most important signs are limp, limitation of motion, and pain at the extremes of motion, especially lateral motion and rotation. In time slight atrophy of the thigh and slight shortening of the femur occur because of the flattening of the head and shortening of the neck.

Laboratory tests are of only incidental value in this disease. The first evidence of the disease in the roentgenograms is a globular swelling of the capsule. The joint space appears wider medially because of a slight lateral subluxation. It appears wider superiorly because of a flattening of the ossified portion of the epiphysis. Soon after the onset, the epiphyseal line appears wider and is irregularly decalcified at its junction with the neck. An irregular dense area soon appears in the capital epiphysis usually in the central portion. Gradually the dense area becomes irregularly decalcified, but it may enlarge at the same time. During the decalcification, the head becomes wider flatter and thinner and the neck becomes thicker and shorter. Gradually the soft tissue swelling subsides the epiphyseal line recalcifies, while the proximal surface of the neck becomes convex and grows into the head. More gradually, the decalcified areas are recalcified. Eventually normal trabeculation occurs, but the head maintains its mushroom shape and tends to remain subluxated.

In untreated cases, coxa plana follows a characteristic course over a period of from 4 to 7 years and always heals but with some residual deformity.

The primary treatment for the disease at the present time is rest. Rest in bed is the surest and simplest way of securing rest for the hip but it must be continued for 2 or 3 years from the onset in the average case. It was used alone in 30 cases of this group. It is especially important in the incipient stage when the symptoms and signs are acute, and, later when there is a great deal of decalcification of the head. Traction for 2 or 3 weeks is desirable for the relief of pain and spasm but it should not be prolonged. Rest should be continued until there is no pain or spasm with motion and until the roentgenograms show sufficient regeneration of the head for safe weight bearing.

The best ambulatory treatment is obtained by the use of a sling and crutches this method was used in about 20 cases of this series. A webbing belt with a shoulder strap, similar to the Sam Browne belt, is used for the sling which is suspended from the belt and encircles the ankle. The lower extremity is thus

suspended with the hip and knee in flexion. The nonweight bearing long leg brace with a built up shoe for the good side may be used but it is heavy and clumsy more expensive, and less satisfactory. Crutches alone may be used, but generally the child cannot be depended upon to keep his weight off the extremity. Immobilization in a plaster cast or traction brace tends to increase the limitation of motion, especially if continued for weeks or months, but it may be used for 2 or 3 weeks for the relief of acute pain and spasm.

The drilling operation was used in about 50 cases from 1928 to 1939 for hastening the healing of the disease process. The follow up period extended from 8 to 18 years. The operation has been found most useful when performed in the progressive stage or in the early stage of repair. The total amount of degeneration and the residual deformity appeared to be reduced by this procedure and the period of convalescence has been shortened by about one third. No new degenerative areas appeared and repair began promptly after the operation. In order to be most effective the operation must be combined with a period of several months of nonweight bearing. Better results were obtained in the group of patients operated upon than in the other group.

JOHN J. CRANLEY, JR., M.D.

**Histologic Studies on Arthritis Deformans of the Hip Joint. Alterations in the Osseous and Cartilaginous Fibrillary Framework. Studies in Polarized Light (Ricerche istologiche nell'artrosi deformante dell'anca. Le alterazioni della trama fibrillare cartilaginea ed ossea. Ricerche in luce polarizzata)** PAOLO LUGIATO *Chir. org. munim.* 1948 33 301

On the basis of the material procured in doing arthrodeses of the hip joints in 15 patients with arthritis deformans at the University of Milan, the author discusses the results. Microscopic sections of from 16 to 20 microns in thickness were studied with Nicol prisms as the source of the polarized light. The microscope used was the Koratka. Eukop with an achromatic objective 22x-5x-45x and a Huyghens ocular 6x and 8x. The polarizing apparatus was the homocentric condenser produced by Koratka. In addition to the simple exposures with the crossed Nicol prisms every specimen was also examined by the chromatic method by inserting between the two prisms a compensator provided by Koratka which consisted of a slab of mica of the proper thickness. The procedure is the same as that used by mineralogists in the study of rock crystals.

It is shown that by this method not only the shape and course of the fibers composing the lamellae of the cartilage and of the bone—for the manner of doubly refracting the polarized light by the fibrils in the cartilage differ entirely from that of the osseous elements—can be demonstrated, but also that changes in their arrangement and composition can be detected before anything abnormal can be seen with the ordinary staining methods of study. It



can be shown how the interlacing fibrils of the surface layer of transversely directed elements first become altered in their capacity of transmitting the polarized light waves and finally lose the power of response and disappear. Next the middle layer of arcuate fibrils are affected and finally the deeper layer of radial fibrils. The subchondral osseous elements then invade the deeper portions of the cartilaginous elements, and finally become eburnated and substitute for the undermined and destroyed cartilage. The behavior of the polarized light in some of these stages is not explainable by our present knowledge of optics and is merely cited by the author as a suggestion for future research in this field.

The findings by this method were finally checked by ordinary dark field illumination methods, and these findings were deemed sufficiently accurate to dispense with the ordinary staining methods.

The author hopes to use this method, not only for the study of arthritis deformans of the hip joint, but of other joint troubles as well.

JOHN W. BRENNAN, M.D.

**General Concepts on Traumatic Parameniscitis of the Knee** (Parameniscitis traumática de la rodilla, conceptos generales) HECTOR DEL LAGO. *Rev. chir. Argent.*, B. Air. 943, 7, 44.

The parameniscus is the space about the meniscus containing blood vessels and nerves. It is believed to be the only part involved in any inflammatory process. Parameniscitis occurs as the result of trauma to the meniscus with or without rupture, or trauma directly to the parameniscus without involvement of the meniscus. Strain or compression of the semilunar cartilage with or without fracture may cause injury to the pericardicular structures and produce edema, vascular and tissue proliferation, pain and swelling. It is contended that these constitute the ruptured meniscus syndrome. The same sequence however may occur without damage to the semilunar cartilages.

Parameniscitis may be acute or chronic, and treatment is rendered accordingly. The condition may regress spontaneously or persist through the chronic stage to cystic degeneration and necessitate resection of the meniscus.

STEPHEN A. ZIEGLER, M.D.

**Radiological and Histological Studies on the Aseptic Osteolysis which is Associated with Vascular Disturbances, with Exceptional Report of a Familial Case of Total Loss of Bone of One Toe of a Foot with Symmetrical Atrophy of All the Other Toes** (Contributo radiologico ed istologico alle osteolisi asettiche accompagnanti le turbe vasomotorie eccezionale rapporto a sfondo familiare di totale scomparsa dello scheletro di un dito del piede con atrofia ossea simmetrica di tutti le altre dita) GIUSEPPE T. MOTO. *Chir. org. merid.* 943, 33, 32.

The author describes in detail the case of a woman who presented since the age of 15 a vasomotor syndrome of all of the toes of the feet. Roentgenographically it was possible to demonstrate a marked atrophy of all the phalanges and total absorption of

all the bones of one toe. Such changes must have had a familial background, because a sister of the patient presented a very similar clinical picture. The author does not enter into a discussion of the differential diagnosis; however, he believes that the syndrome simulates Raynaud's disease.

The author describes in detail the histological changes observed in the patient and the gradual change of the bone to connective tissue also the complete absence of any regenerative action of bone. This gradual change of bone to fibrous tissue is the usual change observed in neurotrophic bone lesions. However this was an unknown clinical picture because there was no resulting gangrene which is the usual complication in this type of case.

The patient was a woman of 32 years of age whose only abnormal background was pulmonary tuberculosis which had been treated for 2 years by pneumothorax. She gave a history of having always complained of cold hands and feet. Detailed laboratory findings are given and the history and photograph of the sister's foot.

The author gives a review of the bibliography and differential diagnosis. Histological studies were made of a biopsy specimen corresponding to the bony part of the fourth toe of the left foot. Microscopic sections showed a fibrotic tissue in various stages of regeneration. The blood vessels showed a cellular hyperplasia of the intima. There was no evidence of thrombosis, necrosis, or exudative phenomena.

CARLO SCUDERI, M.D.

## SURGERY OF THE BONES, JOINTS, MUSCLES, TENDONS, ETC.

**Cup Arthroplasty of the Hip.** WILLIAM H. BAXTER and FRANK S. BARR. *J. Bone Surg.* 1943, 30-A, 647.

Detailed analysis of cases of cup arthroplasty of the hip revealed that patients should be selected carefully for this operative procedure on the basis of (1) physiologic age, (2) temperament and ability to cooperate, (3) reconstructive possibilities of the hip, as analyzed from roentgenograms, (4) muscle power, and (5) occupation.

All patients should be acquainted with the possibilities of failure and success, and the alternate operations should be discussed with them. In case of disease of both hips, or in cases in which degeneration of the opposite hip is expected, there is no alternative. Drilling operations, cheilectomy, fadal arthroplasty and other methods have not stood the test of time. Osteotomy to change the weight-bearing surfaces of an already incongruous and worn-out joint does not seem reasonable. Neurectomy of the obturator nerve may help. It has not proved of great help in relieving persistent pain following cup arthroplasty; however the number of cases in which it has been done by the authors is not great.

Prostigmine has been used after operation in some cases to relieve muscle spasm and pain. The results were not very encouraging, although several patients believed that it helped considerably. Cerebral

been used in conjunction with physical therapy in a few cases to obtain muscle relaxation with equivocal results thus far.

Some of the best results obtained have been in cases in which the degenerative process or mechanical irregularity of the head of the femur was in the formative stage and the acetabulum was involved only mildly. It is difficult to advise early operation for a patient who has distortion of the hip joint without much pain although one knows that ultimately the hip will break down. Perhaps in these cases, cup arthroplasties should be done before secondary osteoarthritis develops.

Comparison of the results recorded prior to January 1943 in the 88 cases in which cup arthroplasty was carried out at the Mayo Clinic with the results recorded in these same cases in this report, reveals a slight trend toward improvement. In 19 cases in which unilateral cup arthroplasty had been performed prior to 1943, improvement had occurred in the past 3 years as follows:

In 6 cases results which were poor at the time of the first study had become fair in 6 cases fair results had changed to good and in 1 case fair results had become excellent. In 6 cases results which were good earlier had become very good. In 10 cases the results had become worse. In 5 of these cases lucite cups had been used. The lucite cups in 3 of these cases are known to have fractured. 1 patient had a late abscess. No reason could be found for the downhill course of the remaining 6 patients. Results in 4 cases changed from fair to poor in 3 from good to poor (lucite cups) in 2 from good to fair and in 1 case from very good to good.

It is the authors' impression that, as the patients gain confidence and muscle strength the motion in their hips generally becomes better and the pain becomes less. A table is included to illustrate the over-all trend in all cases in which follow-up information was available.

Those opposed to cup arthroplasty will focus their attention on the percentage of poor results. It must be remembered however that the patients were severely disabled before operation and that the percentage of salvaged individuals far outweighs the percentage of those who have been made no better.

From this study it seems safe to conclude that vitallium-cup arthroplasty of the hip is a procedure which offers relief from pain, increased motion, and correction of deformity to a great number of patients. The results cannot be positively predicted, but better selection of patients and improvement in surgical technique should increase the percentage of good results from this surgical procedure.

**Osteomyelitis of the Fibula (Le osteomyélite du péroné)**  
V. ACCARDI, *Chir. org. modim* 1948 38 133

Twenty three cases of osteomyelitis of the fibula were observed during the period from 1941 to 1946 at the Orthopedic Center of V. Putti at Bologna, Italy. In 17 patients, more or less extensive resections of the fibular diaphysis were done. In the re-

maining 6 patients conservative measures (immobilization) were employed. The latter patients were not subjected to resection because there was not much disruption of the bone and no evidence of a tendency of the infective process to spread throughout the entire diaphysis.

The periosteum was always removed with the bone in the resections. This was done routinely because all of the patients were adults and the regeneration of new bone was not a factor and because it was feared that the periosteum if retained might result in the production of an osteomyelitic process in the newly formed bone itself. Care was exercised to carry the resection far enough into healthy bone tissue so that there was no danger of leaving infected bone in the stumps. As much of the lateral malleolus as possible was left intact—at least a few centimeters of the lower end of the fibula—in order to avoid the danger of infection of the tibio tarsal joint, and the development of an eversion deviation of the foot.

The results of treatment in every instance were excellent. Cure was attained in the course of 2 or 3 months. Only in 1 case was cicatrization delayed for 8 months. In 1 patient the wound had to be reopened 9 months later to remove a small sequestrum at the upper end of the distal stump. In a third individual a tubular transplant of skin was made to help close the extensive open wound.

On the basis of his experiences with this material the author feels justified in proposing that in the cases of comminuted fracture resulting from gun shot wounds with extensive lesions of the soft parts the diaphysis of the fibula should be resected at once.

JOHN W. BERNHARD, M.D.

**Open Reduction of Pes Varus in Young Infants (La réduction sanglante du pied bot chez le jeune enfant)**  
JACQUES LÉVY and PIERRE BERTHIAUD, *Rev. orthop., Par.*, 1948, 34, 97

A closed reduction of pes varus may be unsuccessful because (1) certain forms especially those associated with other malformations are irreducible (2) the treatment is instituted too late or (3) the correction is insufficient or is not maintained.

True recurrences are rare the great majority of recurrences being due to incomplete reduction combined with an insufficient osteogenesis.

If the conservative treatment fails or the condition recurs tenotomy of the Achilles tendon and an application of a plaster of Paris cast are usually done. The procedure frequently produces an incomplete correction and weakens the triceps muscle. Furthermore peritendinous adhesions not infrequently form. A prolonged immobilization may be followed by muscular atrophy and articular stiffness. Moreover a first reduction may produce grave osteogenic deformities such as flattening of the astragalus or convexity of the sole. Such deformities are favored by decalcification of the bones caused by immobilization of the involved extremity in a cast prior to the renewed reduction. Therefore the authors condemn repeated efforts at reduction and recommend in their

place an operative intervention directed chiefly toward the ligaments and tendons.

Two types of conservative open reduction are employed by the authors (1) a limited operation, reserved for an isolated residual pes equinus usually observed within the first 2 years of life and (2) extensive operations in cases with complicated malformations such as pes varus, pes equinus, metatarsus varus, which are usually found after the first 2 years of life.

The first type of operation consists of an elongation of the Achilles tendon posterior capsulotomy and transcalcaneal traction. The more extensive operations may be subdivided into two groups: operations on the anterior and operations on the posterior parts of the foot. In the last type the Achilles tendon is elongated, the internal malleolus is severed in an oblique direction from above downward and from the inner toward the outer side, and the posterior tibial and flexor tendons are elongated according to the needs.

Slight deformities of the anterior portion of the foot may be treated in the same manner while more pronounced deformities require a supplemental second stage operation consisting of section of the internal plantar muscles. The posterior tibial tendon must remain untouched but the plantar aponeurosis may require sectioning.

The affected extremity remains in the cast for 3 months.

Sometimes the operations must be supplemented by cuneiform external osteotomy of the anterior apophysis of the os calcis or the cuboid. In children older than 4 years a transplantation of the anterior tibial tendon to the lateral border of the foot may be required.

Of 76 children, 15 could not be followed up, while 30 were operated on recently. Of the remaining 41, 16 underwent a bilateral operation. Good results were obtained in 33 patients, 13 of whom were operated on on both sides. JOSEPH K. NARAT, M.D.

#### The Indications and Technique of Surgery of Bone Tumors (Indikation und Technik der Knochengeschwulstoperation) HANS HELLNER, *Chirurg*, 94B, 19: 97

This article is a brief survey of the most important methods employed in the surgery of bone tumors.

Biopsy is necessary in all doubtful cases. It should not be done with the curet but rather with a bone knife or chisel because curettage does not produce good specimens for histologic examination.

Curettage is in most cases sufficient for the treatment of cysts, giant cell tumors, and chondromas. If a large cavity remains after removal, the defect should be filled with bone grafts.

Removal with the chisel is practicable only in exostoses, osteochondroma, and osteoma of the cortex. The periosteum should be removed with the tumor to prevent recurrences.

Resection of the bone together with the tumor is the operation of choice for all benign tumors. If only

a part of the bone circumference is involved in the tumor partial resection is sufficient. Total resection in long bones always calls for subsequent bone transplantation to restore the continuity.

The methods of plastic bone operations are

1. The graft is taken by shifting a piece of bone from the contiguous portion of the same bone. This is possible only in partial resection of long bones. The solidity of the bone is always jeopardized by this procedure.

2. The graft is taken from the tibia, fibula, iliac crest, or rib. The chisel should be used rather than the saw because the heat produced by sawing damages the bone tissue. Either bone chips or a single large piece of bone may be used. In cases in which a large portion of the shaft of a long bone has to be resected, a Knuetscher nail or a Kirschner wire can be used to support the transplanted bone. No for eign body reactions were observed following this procedure. Bones which do not have to bear weight should be resected radically when affected by an osseous tumor. The author removed the entire occipital bone in a giant cell tumor, the suprascapular part of the scapula, the iliac wing, and the arches and transverse processes of vertebrae.

Primary malignant bone tumors should always be treated by amputation. Resection, even in early cases and small tumors, leads almost inevitably to fatal recurrences and metastases.

Bone metastases of malignancies in other organs are very frequent. In persons over 40 years of age, these secondary malignancies are the most frequent of all bone tumors. Usually they are inaccessible to surgery; however there are three exceptions to this rule: single metastasis of a struma, single metastasis of a Grawitz tumor provided the primary tumor had been extirpated years ago, and the pathologic fracture of the femoral neck due to cancer metastasis. The first 2 can be treated by radical surgery as for primary tumors with a good prospect of success. In the case of the pathologic fracture of the femoral neck, operation will save the patient, but internal fixation with a nail is indicated to relieve his pain and to get him out of bed.

Unbearable pains in vertebral metastases or in inoperable primary tumors with pressure on nerve plexuses are treated very successfully by chordotomy. WERNER M. SOLMITS, M.D.

#### FRACTURES AND DISLOCATIONS

##### Recent Advances in the Field of Medullary Nailing. GERHARD B. G. KUENTSCHER, *Ann. chir. gyn. fasc.* 94B, 37: 5.

Eight years have passed since medullary nailing was first done. The recent war has provided excellent opportunities to judge how far the procedure has come up to expectations and on what lines it has developed. Originally the method was inaugurated for the treatment of fresh fractures.

Medullary nailing ensures early movement and good fixation, abolishing the drawbacks and dangers

of immobilization. Postoperative treatment is not needed at all and hospitalization is therefore greatly shortened. The follow-up in 22 cases of fracture of the lower leg showed that there was no limitation of motion in the neighboring joints and in only 1 case was there noticeable waste of muscles. Except in 2 cases no edema of the lower leg nor disturbances in blood circulation could be noted. In 18 fractures of the humerus hospitalization averaged 11 days. All of the patients showed osseous union. The period of recovery was similar in 16 patients with fractures of the forearm. Many of these patients were able to do light work 7 days after the operation.

The only danger in medullary nailing is the danger of shock. A safe principle to follow is that no medullary nailing operation should last longer than an hour. The risk of infection is not very great because the fracture itself is not exposed and it is not in contact with the hematoma of the fracture. The nail is introduced through stab incision far from the site of fracture. There is a risk of infection at the point at which the nail is driven in but this infection does not progress along the nail if the threads are removed. It does not lead to infection of the fracture. Should an infection set in it would be a mistake to pull out the nail. The great advantage of medullary nailing is that it prevents even the slightest shaking motion of the fracture and this complete absence of motion is absolutely necessary for the healing of the infection. The fracture and site of introduction of the nail have to be opened the pus flowing out through the introduction hole and the nail itself acting as a drain. Bone infection in medullary nailing is absolutely typical. It does not lead to osteomyelitis but to local osteitis which also may lead to a characteristic sequestrum. This sequestrum does not affect healing because callus always grows around it. After the extraction of the nail, the sequestrum is easily removed. As the results presented in this article were obtained without penicillin there is reason to expect that the results will be a great deal better in the future.

The presence of abscesses, furuncles and previous wounds is an absolute contraindication for medullary nailing of a simple fracture.

Fractures of the distal third of the tibia can be firmly united only by means of a spreading nail on account of the conical widening of the distal third of the bone. The spreading nail has also been approved for treatment of fractures of the neck of the humerus. The nail is introduced a little above the olecranon and fills the cavity along the whole length of the shaft.

For the treatment of pertrochanteric fractures Y-shaped double nails have been used with success. This type of nail can be introduced via two stab incisions. Ambulation is possible after a fortnight.

Nailing of a simple fracture is done under fluoroscopic control. After the hematoma and edema have been massaged away the bone can be well felt under the skin. By taking it between two fingers reduction is done exactly. After this, Kirschner wires, with the

end ground off are introduced into the medullary space. When the wires leave the marrow space at the fracture a slight resistance of the muscles can be felt. The nails are driven in along the wires after which the wires are extracted.

Medullary nailing is of great value in other fields of bone surgery especially in osteotomy. It is not a mere substitute for the customary methods. It also helps to protect the periosteum and this is essential for nourishing the bone. Medullary nailing has also been accepted in the shortening of limbs, which by this method can be done exactly and with no appreciable risk. The writer recommends his counter incision saw for cases of this kind.

The author lists other conditions successfully treated by this method and concludes by stating that it should be attempted only after a study of the method at a hospital with a long experience in medullary nailing.

RUDOLPH S. REICH, M.D.

**Additional Data Observed in Kuentcher Intra medullary Nailing at the Surgical Clinics of the University of Kiel (Weitere Erfahrungen mit der Marknagelung nach Kuentcher an der Chirurgischen Universitätsklinik Kiel)** HEINZ GRIESMANN AND WILHELM SCHUTTMAYER. *Chirurg* 1947 17 18 316

This article is based on 155 cases of intramedullary nailing observed between January 1, 1944 and January 5, 1946. Fractures of 49 thigh bones, 64 lower leg bones, 14 humeri and 28 tibiae were treated by intramedullary nailing. This procedure was used in children only when conservative well established methods failed.

There were 46 simple fractures of the lower leg bones of which two-thirds were in the lower third of the tibia, less than one third were in the midportion of the bone and 4 were double fractures. It was necessary to use a different type of nail (Doppel Nagel) in the treatment of the oblique fractures. The so-called Spreiz Nagel gave very satisfactory immobilization and only occasionally a plaster cast had to be used for a short period. It was necessary that the nail maintained rigid fixation to counteract the push and pull forces and that callus formation was not impaired.

The operation was carried out by the technique described by Boehler. A small incision was made over the tibial tuberosity. By placing the part into the Boehler apparatus reduction was accomplished with only a little external help and the operation required as a rule from 10 to 15 minutes. In cases in which the marrow cavity was narrower than the nail (especially in the midportion of the bone) the intramedullary nail was reinserted through the medial malleolus.

In simple fractures ambulation of the patient was determined by his general condition. As a rule, patients were allowed to get up after the wound had healed. In the absence of any hematoma and any additional injury the patient was allowed to get up after the fifth day. Weight bearing was allowed after

the twenty-fourth postoperative day and the average patient was able to return to work within 3 months. The nail was removed only after visualization of firm callus formation on x ray examinations and under no circumstances was the nail extracted sooner than 3 months. In 3 cases there was delayed union of the fracture and resection of the fibula was necessary. This procedure was contemplated only after 8 to 12 weeks of delayed union. After resection of the fibula a plaster cast was used.

Intramedullary nailing was done in 15 compound fractures and in 7 cases the fracture united without any complications. Osteomyelitis was not observed.

There were 4 types of callus formation seen in routine x ray examinations (1) "cloudy" callus, (2) scanty callus formation with early and solid union, (3) callus formation predominantly on one side and (4) extensive reaction of the periosteum. The cloudy type of callus formation occurred quite early in the healing of fractures and in the presence of small fragments at the fracture site but only in fractures of the femur. The second type of callus formation was usually seen in fractures treated by nailing and in cases of ideal reduction. The callus formation on one side was seen in cases in which there was rotation of the bone fragments. Callus formation apparently was guided by laws of mechanics, i.e., pressure forces increase callus formation, distraction inhibits callus formation. In cases of angulation at the fracture site, callus forms on the concave side of the fracture. Increased periosteal reaction was usually observed in children and adolescents.

There were 5 cases of pseudarthrosis of the tibia treated with intramedullary nailing. One of the fractures was near the ankle joint. The fracture site was freshened up and an intramedullary nail was introduced. In one case infection developed and the patient was treated along conservative lines with plaster of Paris casts. In the second case the fracture site was freshened up, the nail introduced and the wound was left open with satisfactory results. The intramedullary nail was complicated in one case by the fact that the nail broke and in the second case an oversized nail was used. It is important to select the nail very carefully. In case one is in doubt one should choose the thinner nail. The nail should enter the medullary canal about 3 centimeters with each blow. Once the nail was firmly impacted it was almost impossible to remove it. It is better to cut the protruding portion of the nail off once it is impacted instead of trying to remove it *in toto*. The double nail was used in only very few cases. If the nailing was done correctly no additional immobilization was necessary and the results were excellent.

Patients were discharged on the average after 3 1/2 months. There was no muscle atrophy or limitation of motion of the joints. There was one death. One nail in the femur had to be extracted. The nail was so firmly inserted that the greater trochanter had to be chiseled out. The patient developed a generalized infection and died. In 7 cases of compound fractures

of the femur the healing occurred without any complication. In 3 cases complete healing of the soft tissue parts preceded the operation. Intramedullary nailing of the femur was done in 4 cases of tumor and metastases of the bone. Within 10 days the patients were able to walk without any discomfort. The same procedure was also used with good results in osteomyelitis of the femur.

Intramedullary nailing of the humerus was done through the olecranon fossa or through the greater tuberosity. Nailing was done in 10 fractures of the humerus, 4 of which were pseudarthroses, and 1 fracture with metastasis to the humerus. The average hospitalization was 10 days. As a rule there was only a small amount of callus formed along the fracture site.

There were 18 cases of fracture of the radius and ulna which were treated by intramedullary nailing, 16 of which were closed fractures, a compound fracture, and 10 pseudarthroses. Some patients resumed heavy work 4 weeks after operation and the nail broke. In nonunion of the ulna and radius, bone grafts from the tibia, ribs and fibula were used in addition to nailing. All of the bones healed satisfactorily. The nailing of the bones of the forearm is the most difficult. In a great many cases the fracture site had to be opened. In only one case was an amputation necessary following introduction of an intramedullary nail, because of widespread chronic osteomyelitis of the entire shaft.

GEORGE L. REHN, M.D.

## ORTHOPEDICS IN GENERAL

Hemotogenous Osteomyelitis in the Child (Osteomielitis hematogena en el niño) HELMUT W. JAEGER. Arch. Soc. Cir. Hosp. Santiago, 1945, Sept. 6, 15.

From January 1945 to June 1947 the author has observed 65 cases of hemotogenous osteomyelitis in children of which 35 were acute and 30 were chronic. Eleven of the patients were up to 3 months old, 2 were from 3 months to a year old and 5 patients were more than 2 years old. In from 85 to 90 per cent the causal organism was the Staphylococcus, generally of the aureus hemolyticus type. Age seemed to be a predisposing factor (below 3 months and between 5 and 15 years) and males were involved two or three times more often than females. The disease has a special predilection for the femur and the tibia. The initial osteomyelitic focus is found in the metaphysis and the diaphysis, but rarely in the epiphysis. At this point the bacteria cause an inflammatory process which develops in the connective tissue of the bone ducts and cavities. The exudate becomes rapidly purulent and spreads gradually following the route of minor resistance. The growth cartilage offers some resistance to the infection, but when this is overcome the epiphysis and the joint may become involved.

The acute process gives rise to a series of changes which acquire their full development in the chronic

period. The destructive changes are (a) resorption atrophy and rarefaction of bone and (b) necrosis of bone and sequestrum formation. The productive changes are (a) new formation of bone and (b) sclerosis of the bone. Passage from the acute to the chronic period is gradual and the latter is characterized by the persistence of fistulas and sequestra which keep up the suppuration.

The onset of acute osteomyelitis may be violent or preceded by a prodromal stage of several days with weakness, loss of appetite, rheumatic pains, or urticarial rash. Local and general symptoms vary in severity from case to case and three clinical forms are recognized, localized, hyperacute toxic, and septicopyemic. Under no circumstances should the result of laboratory examinations be awaited before instituting treatment, since more than 90 per cent of the bacteria are penicillin sensitive. When the body has failed to overcome the infection the disease passes into the chronic stage. The following complications were observed in the 65 cases: arthritis in 18 (hip 9, shoulder 2, ankle 1), pathologic fracture in 4 (tibia 3, femur 1), purulent pericarditis in 2, and tibia vara in 1. In the nursing osteomyelitic arthritis of the hip evolves with a characteristic clinical symptomatology: pathologic luxation from destruction of the femoral head is the rule and can often be corrected only by a reconstructive operation.

The earliest roentgen signs appear from the seventh to the tenth day but sometimes only between the fifteenth and twentieth days and from the fourth or fifth day in nurslings. Small irregular zones of reduced density appear in the bone and, while spreading, assume a porous moth-eaten speckled aspect because of decalcification, resorption, and destruction of the trabeculae and thinning or perforation of the cortex. In the second or third week subperiosteal new bone is formed, always less dense than that of the cortex. In chronic osteomyelitis the necrosed bone is denser than the neighboring bone after 3 to 6 weeks and a line of demarcation appears between the living and dead bone. The sequestrum is usually surrounded by a clearer halo.

Treatment may be general or local; the general type consists of chemotherapy with penicillin, sulfonamides, or streptomycin, hydration, alimentation, and transfusions; the local type of immobilization, surgical interventions, and local chemotherapy with penicillin or streptomycin. The two most urgent considerations are the administration of penicillin and immobilization. To be efficacious penicillin treatment must be started early with adequate dosage and continued without interruption for a sufficient time. The author uses an aqueous solution of sodium penicillin intramuscularly in the following dosage: from 20,000 to 30,000 units every 3 hours in children below the age of 2 years; from 30,000 to 100,000 units every 2 to 3 hours in older and adolescent children. The daily dose may also be calculated from the weight of the child from 20,000 to 30,000 units per kilogram. The treatment generally takes 3 to 4 or more weeks and the dosage is reduced

gradually as improvement becomes evident. Immobilization must be instituted as soon as the diagnosis is suspected, and must be maintained until the bone shows satisfactory resistance. The treatment of acute recurrence in chronic osteomyelitis is the same as that for acute osteomyelitis.

In the radical treatment of chronic osteomyelitis penicillin is started from 2 to 4 or more days before intervention which will consist of curettage, sequestrectomy and canalization (sancerization) or antiperiosteal diaphysectomy according to the case. The ideal procedure is then to cover the open bone with a thick layer of soft tissue and to close the skin without drainage. A Nélaton sound is introduced through a small counter opening to instill penicillin. In extensive loss of soft tissues a plastic procedure may be necessary. Residual bone cavities are filled with bone chips and covered with a pedicled skin graft.

With penicillin treatment the mortality of acute osteomyelitis has fallen to from 0 to 15 per cent. In the 35 acute cases of the present series there has been no fatality. Although it is too early to speak about permanent cure, healing was obtained in more than half of the cases when penicillin treatment could be started between the first and fifteenth days of the disease; the average treatment starting before 60 days. The cases which were admitted between the seventh and thirtieth days (average of 15.6 days) became chronic. In 16 of 19 controlled cases it was necessary to incise a subperiosteal or soft tissue abscess; hospitalization ranged from 8 to 90 days with an average of 33.17 days. In chronic osteomyelitis it is even more difficult to evaluate results, however they were frankly encouraging especially in cases in which bone grafts were used.

The evolution and duration of the disease in the nursing are shorter because of the greater speed of the processes of resorption and reconstruction of the bone; the average duration is 2 months. In general the septicemic symptoms predominate over the bone symptoms; however a septicemic and a pure osteomyelitic form can be distinguished. With penicillin therapy there was no fatality among the 13 cases observed. The prognosis for the bone lesion is good as healing is usually rapid, complete and final. However, if the joint or the growth cartilage has been involved, shortening of the extremity, changes in the growth of the axis (genu valgus or varus) and pathologic luxation may occur. RICHARD KEMEL, M.D.

Applied Muscular Physiology in the Healing and Treatment of Fractures (Angewandte Muskelphysiologie beim Knochenbruch seiner Heilung und Behandlung) E. REHN *Chirurg* 1946 17:18-14.

The author believes that both clinical observation and experimental evidence suggest that the muscles play an important role in the healing of fractures. The primary process in the formation of callus has been thought to be hyperemia in the area of the fracture. Rehn however believes that this hyper-

mia is of only transient appearance and usually disappears in about a week. On the other hand the status of the muscles surrounding the fracture their irritability and their other physiological responses closely parallel the healing of the fracture.

Immediately or soon after the fracture has occurred there is a lack of response in the muscles of the injured area which the author calls muscle torpor. After a week, however the muscle displays increased irritability, which he terms intermittent tetanus. It is in this stage that the callus is deposited. The muscle furthermore acts as a guide to the correct reposition of the fractured bone ends. Therefore it serves a useful purpose and only occasionally does its interposition between the fragments cause difficulty.

For this reason the muscle should be treated with respect. Severe distraction will soon cause muscular relaxation and the muscle is then incapable of performing its useful function.

The original muscle torpor is valuable in that it permits the influx of the capillaries of the granulation tissue and the deposition of lime salts. Then the return of the muscle hyperirritability permits the laying down of useful callus. As an example of this it will be noted that the so-called march fractures, which occur in areas which are not covered with muscles, heal poorly with much callus and pseudarthrosis. The best healing is obtained after accurate reposition of the fragments in areas where the muscles run parallel to the bone fragments.

WILLIAM C. BACE, M.D.

**Experimental Degeneration of the Supraspinatus Tendon** CHARLES LAIRD WILSON. *J Bone Surg* 9:2, 30-A, 760.

The pathology of rupture and degeneration of the supraspinatus tendon in human beings has been described in a previous publication. It has been shown that a characteristic type of degeneration precedes and leads to rupture of the tendon. There has been much speculation concerning the cause of this syndrome. The purpose of this article is to describe the experimental production of these pathological changes in the supraspinatus tendons of rabbits.

The supraspinatus tendon was traumatized in 46 rabbit shoulders. These tendons were examined at intervals varying from 42 to 121 days. When the shoulders were re-opened for biopsy only 5 of the subdeltoid bursae had a normal appearance, 19 showed fine adhesions, 17 showed dense adhesions and 5 were completely obliterated.

Some of the evidence of tendon degeneration observed in either partially or completely ruptured human supraspinatus tendons was reproduced in the supraspinatus tendons of rabbits by a single trauma. The microscopic evidence of tendon degeneration was a loss of the normal wavy configuration of the collagen bundles, the homogeneous appearance of the tendon, a change in the character of the staining properties, an increase in the number of blood vessels observed and the loose edematous, fibrillated

appearance of the degenerated tendons. This fibrillation was not so marked as that observed in human tendons which had ruptured.

Of the 46 tendons 87 per cent showed a loss of the normal wavy configuration of the collagen bundles and instead had a homogeneous appearance, 39 per cent showed early fibrillation and 48 per cent showed an increase in the number of blood vessels supplying the tendon.

It is concluded that the degeneration observed in the human supraspinatus tendon is caused by trauma incurred during the life of an individual.

RUDOLPH S. REICH, M.D.

**The Surgical Concept and Treatment of Supraspinatus Tendinitis** (Concepto y tratamiento quirúrgico de la tendinitis del supraspinoso). R. PAEL DE VEGA y FERNANDO DE ANDRÉS. *Rev esp ort* 9:17, 109.

The pathologic anatomy of supraspinatus tendinitis is divided into primary tendinitis or that in which the degeneration changes are ultramicroscopic but in which necrosis of the soft parts is present, and the local metabolism and biochemistry are altered. However there is no calcification but if the condition is not arrested calcification will invariably occur. The second type is calcified tendinitis in which the degeneration has progressed and deposits of one or more calcareous bodies are observed—the latter may occur in as high as 5 per cent of the cases.

Pain and loss of function are the predominant symptoms which together with roentgen views of the shoulder reveal the diagnosis.

The medical aspects of therapy are similar to those of all rheumatoid dyscrasias. Special knowledge of the surgical anatomy and mechanics of the shoulder joint, however, is needed for the proper surgical handling of supraspinatus tendinitis. Operation is directed at restoring the dimension of the acromiobursal space, the elimination of deposits, and the return of the full range of articular motion. To accomplish this, resection of the acromion process may be required and the technique for its extirpation is given in detail. A modified Watson-Jones procedure is employed by the authors.

STEPHEN A. ZIMMAN, M.D.

**Discussion of Physiopathology of the Paw in Volkmann's Disease** Experimental Study of Contracture Provoked by the Intra-Arterial Injection of an Organic Iodine Product (Réflexions sur la physiopathologie de la griffe dans le syndrome de Volkmann. Etude expérimentale des contractures provoquées par l'injection intra-artérielle d'un produit iodo-organique). R. FORTADET, CH. KATZ, CH. MARX, and A. DANT. *Lyon chir* 9:2, 43-49.

While the etiology of Volkmann's contracture is now definitely known, being the result of an arterial lesion, the mechanism of the condition still remains obscure. The fact that ligation of the brachial artery is usually well tolerated minimizes the importance of ischemia. Some writers expressed the opinion that a

reflex originating at the point of injury provokes a spasm of arterioles in the muscles and a dilatation of the capillaries and venules. The resulting peripheral stasis leads to necrosis of the muscle tissue. This hypothesis obviously attributes the main rôle in trauma of the blood vessels similar to the first mentioned theory. The third theory maintains that trauma of the nerves either direct by osseous fragments or by insufficient blood supply and cicatricial tissues is of paramount importance.

There is no doubt that a relatively slowly developing contracture is attributable to an injury of the blood vessels but a rapid development of Volkmann's syndrome is more difficult to explain.

An accidental injection of an organic iodine product into the brachial artery which produced at once an arterial spasm and concurrently also a Volkmann's contracture suggested to the authors the following experiments. A few cubic centimeters of an iodine product called tenebryl and used for intravenous pyelography were injected into the brachial arteries of dogs. A marked contracture developed after 3 to 15 seconds and was accompanied by severe pain and lack of the peripheral pulse. The contractures were registered by means of electromyography. They immediately reached the maximum height and decreased progressively within from 14 to 30 minutes. Direct compression of the brachial artery did not produce a contracture however immediately following the removal of the tourniquet as soon as the injected product could reach the periphery a contracture occurred.

After the section of all the nerve trunks the first intra-arterial injection of tenebryl produced a contracture of a short duration but a second injection had no effect.

A passive extension of the paw during the decline of the contracture provoked by an injection of tenebryl caused an instantaneous intensification of the contracture.

The following conclusions are drawn by the authors from their experiments. Contractures pro-

duced by injections of the iodine product depend on a certain mechanism in the central nervous system as shown by the fact that the section of the peripheral nerves reduces greatly the intensity of the spasm and renders the repetition of the phenomenon impossible. The observation that a passive extension of the paw during the decreasing phase of the contracture intensifies the latter explains some bad results of the treatment of Volkmann's disease by early extension of the flexed fingers.

JOSEPH K. NARAT M.D.

**Voluminous Myeloplaxic Tumors of the Tendon Sheaths of the Ankle with Secondary Osseous Lesions** (Volumineuses tumeurs à myélopaxies des gaines tendineuses du cou-de-pied avec lésions osseuses secondaires) F. CARY *Mém Acad chir* Par 1948 74 549.

A young woman consulted the author because of a deformity and pain in the left lower extremity of 10 years duration. Nine years prior to the examination a fusiform shadow in the roentgenogram was found between the tibia, os calcis and the Achilles tendon. Gradually the tumors increased in size and in 1942 osseous alterations were detected in the form of erosions in both malleoli, the scaphoid, astragalus and os calcis of the involved extremity.

The examination revealed numerous round tumors surrounding the involved ankle. The foot was kept in an equinus position. The tumors of soft consistency were immobile but not adherent to the skin. There were no adenopathies.

An amputation was performed through the lower third of the lower leg. The patient made an uneventful recovery.

The histologic examination revealed myeloplaxic tumors of pseudoxanthomatous character. The tumors were attached to the peritendinous tissues and their vascularization appeared to be of an osseous origin. Apparently the tumors developed not from the synovia of the tendons but from osteofibrous sheaths.

JOSEPH K. NARAT M.D.



# SURGERY OF THE BLOOD AND LYMPH SYSTEMS

## BLOOD VESSELS

**Phlebography in the Localization of Incompetent Communicating Veins in Patients with Varicose Veins.** THEODORE B. MAXWELL AND JEROME E. TINKER. *A. Surg.* 1948, 18:71-17

The late results of varicose vein treatment by high saphenous vein ligation are unsatisfactory because of the presence of incompetent communicating veins detected by tourniquet examination. A phlebographic technique for detection of incompetent perforators is described whereby three tourniquets are placed, respectively just above the malleoli just above the femoral condyles and as high as possible on the thigh. Diodrast is injected into a superficial vein on the dorsum of the foot and films are taken. The tourniquet above the malleoli blocks the superficial venous channels and forces the injected material into the deep veins. If the deep channels are free of obstruction the diodrast does not return to the superficial veins. The two tourniquets on the thigh however provide enough obstruction to the normal flow to cause the diodrast to pass retrogradely through incompetent perforators to the superficial system.

Twenty cases are described in which preoperative localization by tourniquet tests and phlebograms was carried out and operation was then done to verify or disprove the preoperative data and test the comparative accuracy of the two methods. Neither the tourniquet examination nor phlebography correlates completely with the operative findings. Fifty-four per cent of the incompetent veins localized by tourniquet were confirmed by surgery where as 86 per cent localized by phlebography were confirmed. Also incompetent veins not detected by tourniquet or phlebography were found at operation which made the over-all localization accuracy of tourniquet tests 59 per cent and that of phlebography 69 per cent.

Actually the operative findings are not always completely accurate. The anterior tibial veins appear to be the most difficult to be visualized roentgenologically and at times the posterior tibial veins are not completely filled. Visualization of the peroneal veins is almost always excellent. Improvements in roentgen-ray technique and experience in interpretation will probably increase the accuracy of phlebography in localizing incompetent communicating veins. JAMES E. THOMSON M.D.

**Wounds of Common Carotid Arteries. Report of 17 Cases from World War II.** KNOWLES B. LAWRENCE, LAWRENCE M. SIKKES, and JAMES R. McDANIEL. *Am. J. Surg.* 1948, 76: 89.

A series of 17 wounds involving the common carotid artery occurring during World War II is reported. Excluding 1 case the average recorded time lag from

wounding to surgery was 11 6 hours. The artery was ligated in 11 instances with the survival of 8 patients and transient hemiplegia in 2. Of the 5 patients in whom ligation was not done 4 died 2 from arterial occlusion by a thrombus, 1 because of a subclavian hemorrhage from a severed vertebral artery, and 1 following arterial anastomosis by the Birkmore method.

Early wound débridement and direct attack on the arterial defect was preferred in these injuries of the common carotid artery. Immediate ligation is highly hazardous. The extent and spread of the thrombus in the arterial tree and the quality of the pre-existing collateral circulation are the two most important factors in the eventual prognosis, and both are unpredictable clinically. The mortality rate in this series was 47 per cent.

Recent improvements in surgical methods for restoring blood vessel continuity notably by rapid temporary cannalization may reduce the mortality rate and should be employed whenever possible. However the unavoidable time lag before surgery and the inherent inadequacies of the cerebral collateral circulation shown by many individuals will probably maintain the mortality rate at a high level.

ROBERT A. NARAYAN M.D.

**Experimental Studies in Vascular Repair. Comparison of Reliability of Various Methods of End-to-End Arterial Sutures.** HAYES B. SACMACKER, JR., and ROBERT L. LOWENBERG. *Surgery*, 1948, 24: 70.

Since the relative worth of various techniques can be determined by controlled experiments performed upon one artery on one species of animal by the same group of workers, the authors, using the common carotid arteries of dogs compared the reliability of four types of end to end repair. Interrupted plain, continuous plain, continuous mattress, and interrupted everting mattress sutures. Neither techniques involving nonpenetration of the intima nor nonsuture methods were studied. Anticoagulants were not administered.

From these studies it appeared that mattress sutures which fix the opposed ends of the vessel in a position of eversion are superior to plain sutures which bring the ends of the vessel together layer to layer. The superiority of the mattress technique is most evident with regard to the avoidance of such complications as dehiscence, aneurysm, and stricture. There was no significant difference between plain or mattress sutures with regard to the incidence of thrombosis. Also, less bleeding was noted when mattress sutures were used. It also was apparent, although the series was too small for significant analysis, that the chance of success in arterial suture is definitely reduced when one is working with a vessel of extremely small size. No significant difference was

noted between the use of continuous and interrupted suture methods.

Regardless of the method of suture certain fundamental principles must be followed to obtain good results

- 1 The loose external adventitia must be stripped so that adventitia does not fall into the suture line.
- 2 The vessel must be handled gently
- 3 The vessel must not be allowed to become dry
4. Only fine needles and fine nonabsorbable suture materials should be employed and these should be kept moistened with mineral oil or saline solution.
- 5 The vessel wall should be approximated with the intimal layer everted.
- 6 Infection must be avoided

EDWARD H. CAMP, M.D.

**Experimental Portacaval Anastomosis.** RICHARD E. GARDNER, FRANK H. LEEDS and NORMAN E. FREEMAN *California M.*, 1948 69 1

The authors performed an anastomosis of the end of the portal vein to the side of the inferior vena cava in 15 dogs. The operative exposure was modified in the last 9 cases to a right thoracoabdominal incision which extended along the tenth interspace and divided the diaphragm laterally and posteriorly to the attachment of the liver. The hepatorenal ligament

was cut and the kidney pushed down. The antero-lateral surface of the inferior vena cava was dissected free from the entrance of the renal vein to the point where it passed beneath the liver. Dissection of the portal vein from the superior mesenteric vein to its bifurcation at the hilus of the liver was then done. The vena cava was then partially occluded by a modified kidney pedicle clamp and incised longitudinally on its anterolateral aspect for anastomosis to the divided portal vein. Deknatel ooooo and a curved atraumatic needle were used to place everting mattress sutures at each end and the anastomosis was completed with a continuous anterior posterior suture, tied to the everting mattress sutures. The animals were sacrificed at intervals of from 1 day to 4 months postoperatively. There was thrombosis in one instance which they ascribed to some angulation of the portal vein.

This method was used in one patient with portal cirrhosis in whom the approach was modified by entering the ninth instead of the tenth interspace. The patient expired on the fifth postoperative day from hepatorenal failure. At autopsy the anastomosis was patent. The use of a left thoracoabdominal approach for splenorenal anastomosis in clinically doubtful cases is suggested.

LEROY J. KLEMMER, M.D.

# SURGICAL TECHNIQUE

## OPERATIVE SURGERY AND TECHNIQUE; POSTOPERATIVE TREATMENT

Further Studies on the Anticoagulants. CARL REICH and WILLIAM EISENBERGER. *Am J M Sc* 948, 567

This report embodies a continuation of studies on dicumarol and heparin initiated at Lenox Hill Hospital, New York, New York in 1943. Since that time these anticoagulants have been under constant observation at this institution. They have been used both for the prevention and the treatment of thrombotic conditions. Favorable results have been described in previous communications.

The present series of cases including approximately 300 patients can be divided into 4 main groups: (1) postoperative cases in which treatment was given prophylactically with anticoagulants to prevent thrombotic conditions; (2) cases of active venous thrombosis; (3) acute embolic episodes, usually pulmonary; and (4) cases of coronary thrombosis.

Postoperative venous thrombosis and pulmonary embolism can definitely be prevented in all cases by the prophylactic use of anticoagulants.

The treatment of established thrombotic conditions by means of anticoagulants is effective and safe.

In coronary artery disease the main value of the anticoagulants is the prevention of complicating embolism.

The details of the use of heparin and dicumarol are outlined in full. The authors' wide experience is also given in detail.

HARRY W. FOX, M.D.

## ANTISEPTIC SURGERY TREATMENT OF WOUNDS AND INFECTIONS

The Control of Infection in Burns. LEONARD COLLIER, J. M. DUNCAN and W. P. DALLAS ROSE. *Lancet* Lond. 948, 893.

This is the second report on the control of infection in burns at the Birmingham Accident Hospital in England. Since 1945 a serious attempt has been made to treat burns under conditions which aim at eliminating not only infections from contact (hands, instruments) but also airborne infections.

The term "infection" is used throughout in a bacteriological rather than a clinical sense. The term "added infection" connotes the recovery of one of the three "indicator organisms," that is, hemolytic *Streptococcus* (Group A), *Pseudomonas pyocyanea*, or *Bacillus proteus*, if these organisms were not found on any of the patient's burned areas on admission. It is the equivalent of "acquired in the hospital."

The method of treatment of the burned surfaces was essentially the same throughout the three year period. Briefly the wounds were cleansed and penicillin cream was applied. Great care was taken to obtain perfect coverage of the burns, and skin replace-

ment was carried out for the deeply burned areas at an early stage. Penicillin and the sulfonamides were seldom given systemically. Dressings were applied by a team using strict aseptic precautions. All dressings but the first were applied in a special room continuously supplied with an abundant stream of twice filtered and warmed air which escaped by a single exit. An interval of 5 minutes was allowed between dressings for re-cleaning the air. Cultures were taken on admission and at each subsequent dressing.

The outstanding feature of this experience was that it has been possible to eliminate almost completely clinically manifest infections from the *Bacillus hemolytic streptococcus* (Group A) and to reduce the "silent" infections to very few. Only 3.9 per cent (49) of the patients already had an infection from this bacterium on admission but none were seriously ill. The streptococci were eliminated within a few days by the local application of penicillin cream at 2-day intervals. Thirty-eight, or 5.4 per cent, of the patients acquired an infection of this kind during their hospital stay but in no instance was there an infection of the invasive type. In only 14 patients did the *Streptococcus* appear within the first 4 weeks. On the few occasions when streptococci were present on a wound at the time of skin grafting the "take" was poor or nil.

Only 1.8 per cent (13) of the patients had *Pseudomonas pyocyanea* on admission and none of these was admitted early after the burn. However 3 per cent (60) acquired the organism in the hospital. In all but 3 cases transmission of the infection took place in the wards between dressings and there was a close correlation between these added infections and imperfect covering of the wounds. There is much to be learned about the spread of this infection. This organism has never been cultured from the throat or nose swabs of either staff or patients. It appears that the dissemination is by dust and probably flies. However as Neal Owens has pointed out, the imperfectly applied burn dressing may become soaked with serous fluid and be transformed into a mass of culture medium through which pathogens conveyed to the outer bandages will readily grow and infect the underlying wound. A sheet of cellophane incorporated in the dressing serves as an effective barrier.

The usual local applications of antibiotics reported to be efficacious against these organisms have failed. The *Pseudomonas pyocyanea* readily acquires a resistance to streptomycin in the form of a cream. Fortunately not much harm has resulted from the infections, and skin grafting and healing of the wounds has been little affected. However there were 3 cases in which the results were almost disastrous and which reaffirm the urgent need for a therapeutic agent which will eliminate pyocyanous infection from burns as rapidly as penicillin does in the case of the hemolytic *Streptococcus*.

Only 0.8 per cent (6) of the patients had *Bacillus proteus* on their burns on admission while 12 per cent (89) acquired it during their hospitalization. All attempts to eliminate this organism by local application have failed but the organism disappeared as the burns healed.

The *Staphylococcus* has been the most frequent invader of the burns. Only 3 per cent of the patients had this organism on admission but in the more severe cases from 60 to 70 per cent of the patients acquired it at some period of their stay in the hospital. The source of this infection is not clear. In 20 per cent of the patients the organism was recovered from nasal swabs, and during the hospital stay this percentage increased to about 50 per cent. The presence of the *Staphylococcus* in the early stages was associated with slight suppuration and with little or no fever. In a few cases, but not always, the presence of staphylococci on a burn interfered with the successful take of skin grafts. The *Staphylococcus* quickly becomes resistant to local penicillin and especially to local cream applications of penicillin and sulfathiazole.

Infection from *Bacillus tetani* has not occurred in any case and therefore no antitetanic serum has been given.

The great majority of burns which became infected at some period of hospitalization had no pathogens on admission; therefore most of the infections were acquired in the hospital. At least 90 per cent of the infections were due to transmission not at the time of dressing in the specially designed dressing rooms but between one dressing and the next. The transmission took place in the wards and it was clearly associated with imperfect coverage of the wound in most of the cases.

In a few cases serological identity of the streptococcus proved it to have been derived from the patient's own skin or respiratory tract. In the great majority of cases there was no such antigenous origin and the transmission of pathogens occurred by indirect contact from another infected case or by airborne particles.

This study has made it clear that the majority of these injuries can be kept free from any infection that is clinically significant if the proper conditions are provided. Such provision will involve considerable effort and expense. The questions arise: how much does infection really matter? and is all this effort and expense justified?

The clinical picture of the infected severe burn is all too familiar to most surgeons. The antibiotics have improved this picture to some extent, yet the factor of sepsis remains substantially true for most severe burns. Certainly the clinical course of the severely burned patient who does not become infected presents a striking contrast. Such a great change in the clinical course is reflected in the mortality and the period of incapacity.

It is estimated that there are nearly 25,000 burned patients admitted to hospital beds each year in England and Wales. On the assumption that if they

become infected they occupy these beds 10 days longer than uninfected patients it would mean a saving of 250,000 hospital bed days each year. The saving of life and pain, the recovery of full function and the economy of man power and hospital facilities add up to the conclusion that the avoidance of infection in burned patients is the central problem after the management of the shock period.

If that conclusion is valid it means a complete reorientation of our thinking and teaching about burns—we must definitely take as our target the complete elimination of septic infection just as we do for operative surgery. Such a program requires a four fold attack.

1. No pathogens must be allowed to reach the wound at the time of dressing. This means the prevention of transmission from the respiratory tract, instruments, dressings and the air of the room. The use of a specially ventilated room is desirable.

2. No pathogens must be allowed to reach the wounds between one dressing and another. This is a matter of greater difficulty and probably will always be so because burned patients are more easily infected and more infective than any other class of patient. It is far from simple to protect a burn with a proper dressing which offers an effective barrier to bacterial invasion. Even an intact dressing will not afford effective protection when it is soaked with serum for pathogens can grow through it from the outside. Aside from an effective dressing it has been clearly shown that single-bedded cubicles afford the best safeguard against cross infection.

3. The prompt elimination of pathogens from the wounds of those who do become infected is the next objective. By virtue of the power of the antibiotics to control streptococcal infections these infections are now the easiest to control. If we knew how to eliminate the *Pseudomonas pyocyanea* and staphylococcal infections equally promptly certainly the management of a ward full of burned patients would become much easier.

4. The number of raw surfaces must be reduced as much as possible by early and if necessary repeated skin grafting. Yet, however much we improve the set-up for burned patients by nursing in cubicles dressing in microbe-free air and the prompt elimination of pathogens it will never be easy to keep a large raw surface free from infection. The opportunities for such infection will always be numerous and the danger is only past when the raw surface is covered with skin.

There remains for discussion the problem of the finance of administrative management on the control of infection in burned patients. Few hospitals make special provisions for these injuries and the system adopted heretofore of admitting them into general wards of all hospitals cannot be regarded as satisfactory. The treatment is left for the most part to an inexperienced house surgeon. Skin grafting is often not done or is postponed until all sloughs have separated (after 4 to 6 weeks) when the optimal conditions for a successful take no longer exist.

Such arrangements do not offer the burned patients the best or even a good chance of recovery without infection, or recovery with full function.

HARVEY S. ALLER, M.D.

Numerous Tetanus Cases During the Last Phase of the War and Their Treatment with Anatoxin-Tetanus-Formol Toxoid (Ueber gehäufte Tetanus-erkrankungen in der letzten Phase des Krieges und uüber die Behandlung des Tetanus mit Anatoxin-Tetanus-Formol-Toxoid) H. KULTZEN *Chir. wch.* 947 7-8 137

While in Germany the opinion prevailed that a passive immunization against tetanus provides sufficient protection other countries accepted the method of active immunization. The fact that the passive immunization lasts only from 12 to 14 days was sometimes overlooked in patients with several injuries sustained at short intervals and in such instances tetanus occasionally occurred.

Suddenly in 1944 during the battles in the north west region of France the frequent development of tetanus was noticed and in each instance the condition took a grave course. The geographic conditions, intensification of the virulence peculiarity of the injuries and the diminished activity of the prophylactic treatment were considered responsible factors.

The author calls attention to the fact that in Normandy it is customary to employ manure as fertilizer. He is inclined to believe that for unknown reasons the virulence of the tetanus bacilli increased. The kind of missiles was responsible for the increased destruction of tissues. Many wood splinters from collapsing houses were found in the wounds and they favored the tetanus infection. A check-up showed that no serum injected was older than 3 years.

The author calls attention to the fact that in all tetanus cases a prophylactic injection had been given that the incubation period was long, and yet the course of the disease was very grave.

The author considers intravenous serum injections as dangerous especially because an allergy created by previous serum administration may be expected in a large percentage of cases. He also considers doses larger than 50,000 units per day as excessive.

Many surgeons prefer avertin to other sedatives but autopsies repeatedly show a fatty degeneration of parenchymatous organs attributable to that drug. Therefore the author prefers the administration of different sedatives each day.

In view of the fact that none of the war prisoners in whom an active immunization had been employed developed tetanus, the author concludes that this method is superior to passive immunization. The danger of shock from serum is also eliminated when active immunization is employed.

JOSEPH K. KARAT, M.D.

Lat. Tetanus (Spættetanus). HANOS-REINZ FISCHER, *Chirurg.* 947 17-18 681

A 34 year old patient was operated on for peptic ulcer in January 1946. Stomach resection and gas

troenterostomy were performed and uneventful recovery took place. Five weeks after surgery the day on which the patient was to be discharged, infarction was found in the left upper lobe of the lung with elevated temperature and bloody sputum. Seven days after this episode there were pains in the jaw and in the chest, and on the next day there was trismus and typical tetanus. Only at this time did the patient mention that he was wounded by a rifle shot in the left upper part of the chest in November 1943. A fine scar in the left third intercostal space was present which had been overlooked before. The patient expired 8 days later in spite of 100,000 units of antitoxin given intravenously and intramuscularly. No autopsy was performed.

This case is typical for late tetanus. Spores deposited at the time of the first injury may survive for many years and be mobilized by subsequent injury operation or other trauma. The tetanus bacillus is anaerobic. Secondary infections with aerobic bacilli which absorb the oxygen in the tissues create optimal conditions for the development of the spores. In the present case the spores were mobilized by a postoperative lung infarction more than 3 years after the original injury. The extremely rapid course of the disease is characteristic for tetanus of the upper respiratory tract.

In connection with this case the author discusses the question of tetanus of other pathogenesis after abdominal surgery. Tetanus bacilli are found frequently as saprophytes in the stools of normal persons (between 5 and 40 per cent, according to different statistics). The possibility of tetanus infection in operations in which the field is exposed to contamination by fecal matter cannot be ruled out entirely and some authors advise preoperative prophylactic antitoxin in such cases.

WERNER M. SCHMITZ, M.D.

Present Day Tendencies in the Treatment of Gas Gangrene (Iodified odori nella cura della gangrena gassosa). LEONARDO GUL, *Chir. org. mod.* 948, 31: 67

In 34 of 45 cases of gas gangrene amputation proved necessary. There were 26 amputations of the thigh, 5 of the leg and 3 of the arm. There were two extractions of the hip joint. In the remaining 9 patients the treatment was limited to local exposure of the wound trajectories with thorough debridement. The wound edges were either cut down to form a broad depression for the wound or turned back to form a flat surface and no suturing was done. In 4 of these 9 cases demolition procedures could not be instituted because of the location of the wound. In 1 instance the wound was situated in the scapular region and in 3 in the region of the buttocks. In the remaining 5 patients local treatment was judged sufficient because of the localized character of the gangrenous process and because it showed little tendency to spread. In 3 of these 5 instances the wound was in the region of the foot, and in 2 in the region of the leg. Eventually one of these patients with

involvement of the foot had to undergo a leg amputation and 1 with a leg wound had to have an amputation at the thigh.

The total mortality in these 45 cases was 15 (30 per cent). This figure compares favorably with those of World War I but is not as good as those of the allied armies of World War II. The latter however had the benefit of penicillin. Despite the fact that the sulfonamides show considerable activity against the organisms which cause gas gangrene infections treated with these drugs seemed to be just as serious as those treated before the sulfonamides were available. This is true particularly of the oral administration of these drugs. However when used locally in combination with the local and general application of penicillin the association does not seem to be antagonistic and may perhaps be synergistic.

Much may be expected of penicillin not only in the matter of prophylaxis but also in the control of the infection itself. In 2 of the author's patients the use of penicillin enabled the amputation which was adjudged necessary not because of the infective process but because of the circulatory conditions present to be done through tissues which must be assumed to have been infected and thus a useful stump was procured. This certainly could not be attempted before the advent of penicillin.

Of course penicillin or any combination of penicillin the sulfonamides and anti-gas-gangrene serum cannot substitute for delay in getting these war wounds under treatment or for the absence of an adequate force of properly trained surgical personnel. The wound must be adequately exposed, foreign bodies must be removed and the wound must be watched for the earliest signs of gas bacillus infection.

In conclusion the author warns that although gas gangrene is characteristically a complication of fresh wounds it may develop at re-intervention months or even years after the original injury, as happened in 2 of the author's cases. This eventuality is particularly apt to be met with in the cases of healed open fractures. JOHN W. BRENNAN, M.D.

### ANESTHESIA

The Anesthetic Management of Patients with Fracture of the Mandible. S. G. HIZASHY and E. A. ROVENSTINE. *Anesthesiology* 1948, 9, 351.

This is a report of the evolution of an anesthetic technique for operations specifically limited to the fractured mandible without serious involvement of the soft tissues. While the surgical results are not included here they have steadily improved and permitted the oral surgeons to plan a definite approach to a difficult problem. There were no deaths and no serious sequelae relative to respiratory obstruction and aspiration.

Two precautions merit particular mention. Delirium after anesthesia can quickly defeat the entire purpose of the operation by disrupting the reduction and fixation of the fracture. For several years it has been observed that subcutaneous doses of apomorphine are

almost invariably effective in overcoming this complication. The other precaution applies to those instances in which the jaws are to be wired to each other. Aspiration and suffocation resulting from postoperative vomiting are real hazards. It is routine practice to maintain the jaws fixed to each other with rubber bands instead of wire for a sufficient period of time postoperatively so that this accident may be avoided should vomiting occur.

The observations peculiar to the chronic alcoholic patient have been noted as have other lesions of significant value. Of most benefit has been the attitude that the method was still tentative and in need of revision. This produced a variety of solutions for each aspect of the problem and helped to create a technical versatility in managing the individual patient. MARY FRANCES POT, M.D.

### SURGICAL INSTRUMENTS AND APPARATUS

A New Material for Surgical Sutures and Ligatures. Igamid B (Ein neuartiges chirurgisches Naeh- und Unterblutungsanmaterial Igamid B). L. SIKOW. *Chirurg* 1947, 17, 8, 673.

The materials mostly used for surgical sutures, catgut, silk, and linen, present a number of disadvantages. Catgut is usually sterilized in formalin or tincture of iodine. However only the surface can be sterilized with certainty by these procedures and spores or cocci may survive in the interior of the thread, especially if larger sizes are used. This fact accounts for the occurrence of late infections and suppurations when the catgut is in the process of resorption and the interior layers are exposed.

Silk and linen can be sterilized more safely by boiling in 1 per cent mercuric chloride solution, however frequent boiling decreases the resistance against tearing.

During the war I. G. Farben in Germany developed a synthetic substance called igamid B, which proved to be very useful for surgical suturing. Chemically it is closely related to nylon. As it is manufactured at a temperature of 300°C it is absolutely sterile. Its further advantages are that its resistance against tearing is extremely high about the same as steel, so that much thinner threads can be used than with catgut or silk. Threads of any diameter can be produced. It does not swell by imbibing tissue moisture. It can be stretched about 15 to 20 per cent and is completely elastic. It can be sterilized by boiling any number of times without losing its original physical properties. It does not cause any local irritation.

The only disadvantage seems to be that the surface is very hard and smooth. This necessitates a special technique in tying knots to prevent slipping. Experiments with braided threads are under way to overcome this difficulty.

Also other surgical instruments have been made from this material, sheets to close defects in the abdominal wall in large abdominal hernias, bone holders, bone nails, and wires.

WERNER M. SOLMITZ, M.D.

**Supramid a New Synthetic Substance in Surgery**  
(Supramid—ein neuer Kunststoff in der Chirurgie)  
F. LUDWIG and M. SCHWABERGER. *Chirurg* 1947  
17: 8, 675.

Supramid is identical with Igarid B which has been described by L. Simon. This article confirms the facts reported by Simon. Chemically supramid is a so-called superpolyamid and it is closely related to nylon. Its physical properties are

Specific weight 1.13

Resistance against bending kgm./sq. cm. from 200 to 400

Resistance against tear kgm./sq. cm. 500

Melting point, Centigrade between 210 and 215

Heat resistance Vicat centigrade between 160 and 180

Heat conductivity  $20^{\circ}$  cal./cm. sec. Centigrade from 50 to 60

Imbibition with water in weight, per cent. 12

It is resistant against boiling and steam sterilization. It can be produced in any desired shape. Thin threads of 0.15 mm. in diameter are available, as well as ribbons for the covering of bone defects in the skull or orthopedic protheses. It can be welded, drilled, sawed, and polished. It is however, not hard enough to replace steel in bone nails. It is not resorbed in the body but, in contradistinction to other materials, it does not cause any foreign body reaction in the tissues. It is much more solid and resistant against bending and traction than silk or catgut.

Because of these properties supramid is an ideal material for many purposes in surgery. In addition to its use for skin and muscle sutures and ligatures, it has been successfully used in suturing and replacing tendons, suturing spiral fractures of the tibia and humerus, transplanting bone, covering traumatic defects of the dura, and in plastic operations for saddle nose.

WERNER M. SCHWABERGER, M.D.

# PHYSICOCHEMICAL METHODS IN SURGERY

## ROENTGENOLOGY

**Obstructions of the Alimentary Tract in Infancy**  
WILLIAM A. EVANS, JR. *Radiology* 1948 51 23.

With the increasing success in the treatment of the infectious diseases of infancy and childhood by the use of the various antibiotics and chemotherapeutic agents as well as the adequate meeting of the nutritional requirements in infancy the importance of congenital malformations assumes increasing stature. The advancing knowledge of surgical techniques and more accurate methods of diagnosis make a number of previously hopeless congenital lesions of the alimentary tract amenable to some degree of correction.

The author reviews the more common obstructing or potentially obstructing lesions of the alimentary tract in 400 infants seen at the Children's Hospital of Michigan, Detroit, in the past 7 years. While 50 per cent of the lesions seen were diagnosed as hypertrophic pyloric stenosis, only 19 per cent of these were subjected to radiological examination. The age of greatest incidence in this group of infants was 6 weeks.

Twenty per cent of the lesions seen were due to intussusception and only 30 per cent of these were subjected to radiological examination. The age of greatest incidence in this group was 5 months. Atresia meconium ileus constricting bands, and volvulus comprised only 23 per cent of the lesions but this was the group that received most of the roentgen examination.

A brief clinical and radiological review of the pertinent points in the diagnosis of each of the lesions is given. Mention is made of functional obstructions of the alimentary tract resulting from intracranial birth injuries, as well as congenital absence of nerve cells in the lower ileum or colon. Diaphragmatic hernia is mentioned as an occasional cause of obstruction in the very young.

ROY GREENBERG, M.D.

**The Roentgen Appearance of the Chest in Diseases Affecting the Peripheral Vascular System of the Lungs. Conditions Associated with Increased Vascular Permeability** ROBERT P. BARZEN AND DAVID A. COOPER. *Radiology* 1948, 51 44.

This article considers the roentgen appearance of the chest in certain clinical states associated with increased permeability of the pulmonary vascular system. A table listing many of the disease conditions affecting these blood vessels in this way is included. By means of a chest roentgenogram the changes produced by the altered permeability of the pulmonary vessels can be visualized and this reflects the condition of the peripheral vascular system in general. Reproductions of roentgenograms illustrating these changes accompany a discussion of the following

clinical conditions in which alterations in the permeability of the pulmonary vascular bed occur: trauma to the chest, epidemic influenza, disseminated lupus erythematosus, acute rheumatic fever, exfoliative dermatitis, acute glomerulonephritis, periarthritis nodosa, and Loeffler's syndrome.

The authors point out that these diseases all present a rather uniform pathological, clinical, and radiological pattern that results from the changes produced in the peripheral vascular system by hypersensitive states. Indeed it is the hypersensitive reaction in the individual patient, which may be caused by a multiplicity of disease agents that is the common denominator. The pulmonary vessels participate in this reaction and produce a fairly characteristic roentgen appearance of a bilateral symmetrical patchy to uniform haziness usually in the upper portions of the lung fields either peripherally or in a perihilar location. These infiltrations are transient and change rapidly making serial examinations necessary in order to ascertain that they are characteristic of peripheral pulmonary vascular disease. The radiologist, by being cognizant of this type of reaction in the vascular system of the lungs, can more effectively aid the clinician in arriving at a diagnosis.

D. B. NAGLE, M.D.

**Some Considerations of the Roentgen Diagnosis of Silicosis and the Conditions that may Simulate It.** EUGENE P. FENTON-GRAN and AGATHA G. ROBERT. *Radiology* 1948 50 735.

The authors emphasize the fact that a fluoroscopic and roentgenographic examination of the chest constitutes the best method for demonstrating in the living individual the pathologic changes produced by pneumoconiosis or silicosis. It is necessary however to correlate the roentgen findings with all other available data before a proper diagnosis can be made. An ideal although somewhat too ambitious, arrangement would be to have a group of consultants consisting of a general physician, a rhinologist, a bronchologist, a clinical pathologist, a specialist in tuberculosis, a physiologist interested in the heart and lungs, an engineer (expert in industrial hygiene) and a general roentgenologist.

"Pneumoconiosis" is a broad generic term which includes all forms of pulmonary reaction due to dust lodging within the lungs. A subdivision into the specific (silicosis and asbestosis) and nonspecific or benign pneumoconiosis has certain practical advantages. The former may be productive of disability whereas the latter is of clinical significance only because it may lead to error in diagnosis.

The common features of silicosis and asbestosis are that they result from inhalation of the dust, are capable of producing a progressive pulmonary fibrosis and lead to characteristic though radically different roentgen images.



The silicosis is due to the specific action of the chemically free silicon dioxide in finely divided form on the lung tissue. The inhaled dust first exerts its toxic influence within the bodies of the alveolar phagocytes. Degenerative changes, easily confused with those in the "epithelioid" cells of tuberculosis quickly become evident. Lipoid deposition and giant-cell formation constitute part of the picture. The migrating phagocytes eventually concentrate the silica in and about the pulmonary lymphatics stimulating consecutive tissue proliferation and resulting in the formation of the silicotic nodules situated in the immediate vicinity of the lymphatic vessels. The alveolar phagocytes will collect upon the walls of the air spaces proper and lead to the formation of parenchymal silicotic nodules.

Some inert dusts as for example aluminum when mixed with free silica may cause a retardation in the development of the silicotic process.

On the other hand silicosis increases the susceptibility to tuberculosis. Two facts must be stressed (1) that it is the presence of associated infection which accounts for most of the disability arising from silicosis and (2) that infection when it occurs may manifest itself in either of two ways namely by the development of tuberculous nodules or of silicosis with tuberculosis the latter being the less frequent.

The criteria for diagnosis of silicosis include a positive history of sufficient exposure to free silica dust the roentgen demonstration of characteristic shadows and various physical and laboratory findings which exclude other conditions.

The roentgen manifestations of simple silicosis and of silicosis complicated by the presence of coexisting infection are detailed. The demonstration of a generalized nodulation uniformly distributed throughout the pulmonary parenchyma is of fundamental importance in simple silicosis. A subdivision into the three stages in the development of which Gardner and Sampson had a prominent role may have some practical value but according to the authors it is the nature of the lesion that should invariably be emphasized rather than the stage of development.

The tuberculousosis is a distinct entity resulting from prolonged interaction of the two disease processes but differs radically in its behavior from either occurring alone. Therefore the roentgen manifestations may be quite variable and necessitate repeated careful studies.

Silicosis with tuberculosis occur in one of two forms either (1) the result of infection superimposed upon a progressive and still active silicosis or (2) as the result of infection superimposed upon an old and already stabilized silicotic process. In both groups the infection component is first identified on the roentgenograms by simple or multiple areas of infiltration or mottling superimposed upon a background of discrete nodulation. The subsequent behavior, however may lead to roentgen images rather difficult of interpretation.

The criteria for the diagnosis of a metastasis are not reviewed in the present article.

Of the nonspecific pneumoconioses, the authors briefly discuss baritosis, siderosis, the pseudonodulation due to inhalation of tin oxide, the talc pneumoconiosis and the pneumoconiosis due to vanadium pentoxide.

Other confusing causes of nodular densities within the lungs are also discussed. These include tuberculosis, histoplasmosis, mycotic infections, hemangiosarcoma, polycythemia vera metastatic carcinoma, Boeck's sarcoid and the chronic pulmonary granulomatosis in beryllium workers.

The article is abundantly illustrated with roentgenograms and a bibliography of numerous articles is appended. T. LUCCHINI, M.D.

**Tb Roentgen Diagnosis of Rickets Associated with Other Skeletal Diseases of Infants and Children.** RALPH S. BROWNE AND R. LEE M. HARTY. *Radiology* 1935, 31: 1.

The simultaneous occurrence of rickets with scurvy, congenital syphilis, lead poisoning, erythroblastosis anemia, and osteogenesis imperfecta is discussed.

When rickets and scurvy occur simultaneously the problem of recognition is difficult. However the authors believe that the diagnosis can be made with a high percentage of accuracy in certain cases. In most of the combined cases the signs of scurvy obscure those of rickets unless the latter is severe.

The signs of identification of the combined diseases are:

1. Rarefaction of the cortex is of the rachitic moth-eaten type rather than the scorbutic ground-glass type.

2. In the enchondral metaphyseal area the signs of rickets predominate and may prevent the characteristic signs of scurvy.

3. In combined cases the osteoid zone of rickets can be diagnosed by a marked increase in the clear space between the epiphyseal center and the end of the diaphysis.

4. In the combined cases the ring sign about the epiphyseal center remains intact, which is indicative of scurvy.

5. Spreading of the diaphyseal ends cannot be considered indicative of either one or the other of the diseases. The distinction between the lateral spur of scurvy and the cupping of the diaphyseal ends of rickets can be made only by vertical projections through the zone of temporary calcification.

6. Periosteal triangular shadows of slight width compared to those usually seen in scurvy are indicative of scorbutic hemorrhage merged with rachitic periosteal elevation.

When rickets and syphilis coexist the only signs present are those of rickets. The periosteal involvement is so similar in the two conditions that differentiation is impossible.

In rickets with lead poisoning the characteristic lead line at the diaphyseal ends of the long bones fails to develop.

The authors quote the case of Caffey (*Am. J. Roentg.* 1937, 37: 203) in which rickets was super-

imposed on erythroblastic anemia but state only that the diagnosis of rickets could be made roentgenologically

The case of osteogenesis imperfecta in which rickets and scurvy developed was reported previously by Bromer (*Am. J. Roentg.* 1946 55 30) This case showed the signs of osteogenesis imperfecta and the usual signs of rickets i.e. decalcification flaring of the diaphyseal region of one radius, and an osteoid zone distal to the frayed out zone of preparatory calcification Six months later the child had unmistakable signs of scurvy JOHN O. LATTERTY M.D.

The Skeletal Lesions in Leukemia FREDERIC \ SILVERMAN *Am. J. Roentg.* 1948 59 819.

The author reports the clinical and roentgenographic observations in 103 leukemic infants and children who were admitted to the Babies Hospital in New York during the period from 1924 to 1947 The ages at the onset of the symptoms varied from 22 days to 12 years and 7 months. More than 70 per cent of the patients died within 7 months after the clinical onset of their disease. Abnormal white blood cells were found in the peripheral circulation in 102 of the 103 cases. Forty patients had persistently high counts that is above 12,000 white blood cells per cubic millimeter and 27 had persistently low counts below 12,000. The presence of an increased erythrocyte sedimentation rate was a related finding in almost all of the cases. Fifty two of the 103 leukemic children showed bone changes in their roentgenograms. Four types of lesions were found: transverse bands of diminished density, osteolysis, osteosclerosis and subperiosteal new formation of bone.

Frequently more than one type of lesion was present in a single patient. Forty two patients complained of pain. 25 had skeletal lesions demonstrable in roentgenograms, and 17 presented no lesions. No significant correlation was observed between the sites of the pain and the sites of the lesions. Seventeen patients complained of pain but showed no lesions. Of the 52 patients with lesions 25 had pain and 27 had no pain. Thirty-four of the 103 patients had no lesions and no skeletal pain. Transverse bands of diminished density occurred at the ends of the shafts of long bones in 14 patients. Osteolytic lesions occurred in 39 patients, osteosclerosis occurred in 9 patients and subperiosteal new bone formation occurred in 17 patients.

Associated roentgen findings outside of the skeletal system which were often helpful in the diagnosis were enlargement of the lymph nodes, mediastinal tumors and enlargement of the adenoids.

The diagnosis of leukemia in infants and children is often made difficult by factors which do not operate significantly in adults. Chief among these are the tendency of nonleukemic children to produce immature white blood cells in response to severe infections and the frequent absence of leukocytosis in children with leukemia. The demonstration of leukemic changes in the bones by roentgen examination

provides valuable information for the detection of leukemia during early life.

FRANK L. HUSKEY M.D.

Studies of the Circulation by Roentgen Cinematography NILS WESTERMARK. *Radiology* 1948, 50 791

The author reviews the experimental work that had been carried out formerly by various methods for the study of the velocity and circulation time of the blood and their relationship to the cardiac contraction. He also discusses the earlier physiological attempts at recording the cardiac movements. In particular the role of the movements of the atrioventricular junction for driving out the blood from the ventricle is stressed.

In a recent publication the author described how roentgen cinematographic and simultaneous electrocardiographic examinations were carried out on the hearts of sheep with metallic indicators implanted in the myocardium in different parts of the left ventricle. By this method some new observations were made on the expulsion of the blood from the ventricle.

Our knowledge of the dynamics of the heart is based mainly upon pressure curves taken simultaneously from different parts of the organ and from the vessels. Lewis has established diagrams representing the curves of pressure in the carotid artery, aorta, left ventricle and right auricle of the human being and demonstrated the supposed or ascertained time relations of these curves, the jugular pulse curve, the electrocardiogram and apical heart sounds to each other. The author reproduces Lewis diagrams and discusses the various factors in lengthy detail.

He then proceeds to describe the technique of his own experimental study of cardiac contraction and its relationship to the blood circulation by means of indirect roentgen cinematography of the contrast filled circulatory system. The experiments were carried out in rabbits by injecting 20 gm. of thorotrast corresponding to 1 or 1.4 per cent of the body weight of the animal into the jugular vein. The circulation was recorded by cinematography of the fluorescent image produced by roentgen exposure. The timing of the various phases of the circulatory cycle was determined by means of electrocardiograms which were made simultaneously, a photo tube being used for the synchronization. The thorotrast was found to mix well with the blood and gave a homogeneous shadow. Altogether 50 experiments were made.

It was found that the rapid inflow of the blood into the ventricles occurs during the presystole and not at the beginning of the diastole as was formerly assumed. The expulsion of contrast blood from the ventricles would also seem to occur later than demonstrated by pressure determinations.

According to the experiments the expulsion through the arterial ostia occurs at the beginning of T and not immediately after S as shown by pressure determinations. The closing of the atrioventric

ular and semilunar valves takes place as observed formerly.

The author gives the following interpretation of these observations:

It seems probable that the systolic contraction of the ventricle begins with a contraction of the inter-ventricular system, in which the septum is shortened and the central part of the atrioventricular junction is drawn toward the cardiac apex. When this contracts, the wall swells and the inner contour of the apex moves, together with the septum toward the base, the retrograde movement of the atrioventricular junction taking place simultaneously. Then the contraction will continue along the external ventricular walls up toward the arterial ostia. This continuous systolic contraction starts with the commencement of the QRS-complex and finishes at the end of T when the contrast blood has been almost completely expelled from the ventricle and the semilunar valves are closed. Systole once complete the ventricles will not relax immediately. This might explain the fact that no filling of the ventricles is distinguishable until P when rapid flow of contrast blood to the ventricle sets in. T. LEVOTZ, M.D.

**Röntgen Treatment for Extensive Epithelioma of the Larynx; Results in 139 Cases.** ARTHUR U. DESJARDIN, FREDERICK A. FOL, and LUTHER M. VAUGHAN. *Am. J. Roent.* 1948, 60, 9.

The authors review and analyze a series of 139 cases in which epithelioma of the larynx had been treated with fractional doses of roentgen rays from 1936 through 1945. All the patients had extensive epithelioma and in most of them the neoplasms were so extensive that surgical treatment was not considered advisable.

In 56 of all the patients included in this series of 139, tracheotomy was not performed at any time. Tracheotomy was performed before roentgen treatment in 76 cases during the course of roentgen treatment in only 1 case and soon after the course of treatment in 6 cases.

All patients were treated with rays generated at 200 peak kilovolts, filtered through a Thoraeus filter consisting of 0.4 mm. of tin, 0.35 mm. of copper and 1.0 mm. of aluminum at a focal-skin distance of 50 cm. The half value layer was equivalent to 1.75 mm. of copper. In most cases the treatment was given through two lateral fields (one on each side) each of which measured from 8 by 13 cm. to 15 by 18 cm. but in a small number of cases the treatment was given through three fields (two on one side and one on the other). When two fields on one side were employed, they were on the side on which the bulk of the malignant process was situated.

Of the 139 patients in the entire series, 71 were treated between 1935 and 1945 inclusive and of 3 of these the authors were unable to obtain recent information. This left 68 patients who were treated during this period and who were living more than 3 years since their treatment at the Mayo Clinic. As percentages of "cured cases" go, this proportion is

not as high as might be expected but, considering the initially unfavorable character of these cases and the extensive malignant neoplasms from which the patients suffered even this percentage seems worthy of consideration. There is no doubt that if these patients had not been treated in the manner described by the authors all of them must inevitably have died in short order. Moreover the pronounced relief of symptoms and improvement in the general condition which in the patients who died, had occurred after treatment cannot be estimated.

**Röntgen Therapy of Malignant Tumors of the Testis.** EDWARD T. LINDT. *Am. J. Roent.* 1948, 60, 39.

Seminomas and malignant teratomas together constitute about 95 per cent of all malignant tumors of the testis. Seminomas are encountered about six times more frequently than malignant teratomas. Both of these tumors occur during the years of greatest sexual potency, but the maximal incidence of teratomas occurs earlier in life than does the maximal incidence of seminomas.

The author states that the adoption of Broders' classification would go a long way toward correcting the confusing and contradictory views about testicular tumors.

A distinction by the pathologist of seminoma from malignant teratoma gives the basic indications on which roentgen therapy may be planned. Orchiectomy is advised both as a diagnostic and therapeutic procedure even in the presence of known metastatic lesions in all but very exceptional cases. After a brief period of postoperative convalescence it is the practice at the Mayo Clinic to administer a course of postoperative radiotherapy. Recently malignant teratomas have been exempted. Radium was used in the early days, but because roentgen therapy is, as a rule, more practical, more efficient, and more expedient than radium therapy radium is now seldom used.

It was the author's opinion at the time the report was written, that irradiation of seminomas of the testis and their secondary deposits could best be carried out with roentgen rays of moderate voltage (130 to 140 kv). Prophylactic postoperative treatment, if it is to be truly protective against metastasis, should be applied to all lymphatic pathways through which metastasis may take place. This, obviously makes extensive treatment necessary.

Some tumors may be a mixture of a seminoma and a teratoma. In this case, the initial response of the tumor may be satisfactory because the seminoma is destroyed however after the initial response has taken place the residual tumor may not respond and the tumor may grow in spite of treatment. For the treatment of seminomas, roentgen therapy has assumed a position of prime importance and has altered the prognosis from one of hopelessness to one of subdued optimism.

Since the radiosensitivity and, therefore, the prognosis of seminomas are completely different

from the radiosensitivity and prognosis of malignant teratomas accurate pathologic diagnosis as a basis for roentgen treatment is justified. The author describes a method of treatment which is said to be as effective as any reported and safer than many it is based on extensive experience

#### MISCELLANEOUS

**Neutron Therapy and Specific Ionization** *Jane-  
way Memorial Lecture, 1947 ROBERT S. STONE.  
Am J Roentg., 1948, 59, 771*

The author reviews the results of intensive treatment of human cancer between 1938 and 1943 with neutrons. Neutrons are particles of matter of the same weight as the nuclei of hydrogen atoms. They have no electrical charge. They are obtained by knocking them out of atomic nuclei by bombardment with high energy photons or atomic particles. The physical measurement of neutron radiation in air in units that can be translated to tissue doses comparable to tissue roentgens has been difficult. The N unit of exposure is physically equivalent to about 2.5 roentgens as judged by the amount of energy absorbed from a beam by tissue. In other words 1 N equals 2.5 rep (roentgen equivalent physical). The biological work on the Plutonium Project, and the work on human beings here reported show that the relative biological effectiveness of neutrons compared to roentgen rays is greater in the late results than in the early ones.

The method used at the University of California to obtain a beam of fast neutrons was by means of the cyclotron devised by E. O. Lawrence. From September 26, 1938 until June 29, 1939 a total of 24 patients were treated on the 37 inch cyclotron with 8 mev deuterons to produce the fast neutrons. Beginning in November 1939 and up to February 1943 the cyclotron with 60 inch pole faces which gave deuterons with 16 mev of energy was used. The total number of patients treated was 226. Thirty-one patients did

not complete their courses of treatment. A few of the patients had only one treatment. One patient was treated on both cyclotrons and is included in both totals. On January 1, 1948 17 of the patients were alive and all but nine who lacked only 1 month had lived more than 5 years from the day of his first treatment. All of the patients with one exception who were treated with fast neutrons were considered incurable. All kinds of malignant conditions were treated. Many of the patients had had previous treatment with other methods. Sixteen patients who received complete courses of treatment with fractionated doses of fast neutrons have been observed for more than 5 years. Thirteen of them had severe epidermolytic reactions in all treated areas. 1 had epidermolysis in one of the 3 fields. 1 had an erythematous reaction and 1 had only desquamation. Most of them had severe early reactions. Eighteen patients were kept alive. They all had severe late reactions. 12 of them had such severe changes that they were partially incapacitated. The late tissue reactions consisted of marked skin atrophy, telangiectasis, loss of subcutaneous fat, contractions of the scarred area, and fibrosis of the muscles. In lesions of the mouth, pharynx, and larynx there was persistent ulceration at the site of tumor regression. Some of the patients with lesions that were treated through the mandible developed radiation osteitis. When treatments were given through the pelvis the effects on the intestine were quite severe.

From the study of the patients treated with neutrons it is clear that cancer cells can be killed and patients cured of their cancer but the difference between the dose required to kill cancer and that to damage normal tissue acutely is very small. Eighteen patients were kept alive but none of them were free from distressing late effects. Anyone contemplating the use of new radiations, such as multimillion volt protons, beta rays, and roentgen rays on patients should study their late biological reactions as well as their acute early ones. **FRANK L. HUSKEY, M.D.**



Yet if the foregoing possibilities are borne constantly in mind the results achieved often justify the risks involved. The procedure itself is basically simple and the apparatus can be constructed and assembled in any hospital. Facilities for preparing sterile perfusion fluid in large amounts must be available as well as an adequate clinical laboratory for analysis of the blood counts, chemical examination of the blood and the other indicated studies. Beyond this is needed an interested clinician informed as to the basic physiology of the peritoneum as a dialyzing membrane and as to the water and electrolyte requirements of the patient, and with mind and eye alert for the development of complications.

It is the opinion of the authors that when acute suppression of renal function with increasing renal insufficiency develops several days of routine intravenous therapy and supportive measures should first be employed in an attempt to promote the formation of urine. If at the end of this time conservative measures have failed and it appears that fatal termination of the case may result, the procedure of peritoneal lavage should be initiated as a lifesaving measure. A discussion of procedures and the data pertaining to 6 cases is included.

#### The Rapid Injection of a Solution of Amino Acids. RICHARD D. ECKHARDT and CHARLES S. DAVIDSON *Y. England J. M.* 1948, 129, 164.

A 10 per cent solution of amino acids prepared by the complete acid hydrolysis of casein devoid of peptides, largely freed of glutamic and aspartic acids and supplemented with DL tryptophane and glycine was administered 341 times to 62 subjects at the Thorndike Memorial Laboratory Boston City Hospital Boston.

Over 70 per cent of all infusions were administered at rates usually unattainable with the previously available protein hydrolysates (50 gm of amino acids in 70-kgm subjects in less than an hour). All injections supplied at least 0.5 gm of protein per kilogram of body weight and many of them were larger.

The clinical tolerance of the solution of amino acids was evaluated in normal subjects as well as in patients with a variety of illnesses requiring parental protein therapy. However, there was no apparent difference in the clinical tolerance of the amino acid solution whether it was given with glucose saline solution lactate or vitamins or when it was given repeatedly.

The incidence of pyrogenic reactions was 0.3 per cent, nausea, 0.4 per cent, vomiting, 2.6 per cent, venous thrombosis, 3.3 per cent and transient anorexia 0.1 per cent.

Because of the rapid rates of infusion attainable with but few untoward reactions, it was concluded that the solution of amino acids employed in this study was better tolerated in man than the protein hydrolysates previously used.

ROBERT MAYO TENERY M.D.

#### Calcifying Epitheliomas of the Skin (Type Maffuerbe) KAI STRALL. *Ann. chir. gyn. fenn.*, 1948, 37, Supp. 3.

The author examined 29 cases of a new type of tumor. These calcifying epitheliomas were located in the subcutis and seemed to lack even a slight epithelial connection with the overlying dermis. The tumor itself was composed of numerous epithelial cell masses or bands each of these being separately surrounded by a single layered mantle composed of cuboidal or cylindrical epithelial cells. The medullary portion was formed of squamous-celled elements, which possessed a particular tendency to retrogressive alterations. The tumor was surrounded by a connective tissue capsule which often showed a well developed network of capillaries. The tendency of the epithelial portion to form tissue of a lower vitality was no doubt the essential factor in influencing the microscopical picture of the calcifying epitheliomas. From the surrounding capsule like formation, newly formed invading connective tissue grew and replaced the changing epithelium. This connective tissue had either undergone hyaline degeneration and later become calcified or had actually begun to ossify.

The author expresses the opinion that the calcifying epitheliomas might be derived from hair follicles. The microscopical examination revealed in 3 cases signs which justify the statement that the tumor may be only 'locally' malignant. In none of the cases had the infiltrative destructive growth progressed far enough to destroy the surroundings to any extent.

JAMES WEAVER, M.D.

#### Hemangiomas of Striated Muscle. C. FRED GOER. *INORR. Am. J. Surg.* 1948, 76, 58.

The author reports 3 cases of hemangioma of striated muscle. The first was that of a Chinese 22 years old who had a 1 year history of swelling of the lower inner aspect of the right thigh. A cavernous hemangioma of the sartorius muscle was found and excised. Only one other case has been described in which the tumor was confined entirely to that structure. Case 2 was that of a 19 year old white female complaining of pain in the left calf and inability to dorsiflex the left foot of 3 years duration. A cavernous hemangioma of the calf muscles was found and removed. Case 3 was that of a 15 year old school girl who complained of a swelling of the inner aspect of the left elbow noted 5 years previously. At operation the tumor was found to consist of dilated veins in the substance of the flexor sublimis digitorum muscle. The upper 2 inches of the muscle was removed and the lesion proved to be a cavernous hemangioma.

Almost half of the patients whose cases were recorded in the literature displayed symptoms before the age of 11 years. It is a disease that usually occurs in the first three decades. The incidence of hemangiomas is approximately equal in males and females. These tumors are predominantly congenital in origin. The lesion presumably arises in the vascular plexus of the muscle or in the peri-









# SURGERY

## GYNECOLOGY AND OBSTETRICS

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### CARCINOMA CELLS IN SPUTUM AND BRONCHIAL SECRETIONS

#### A Study of 150 Consecutive Cases in Which Results Were Positive

LEWIS B WOOLNER M.D., and JOHN R McDONALD M.D., Rochester Minnesota

THE occurrence of grossly visible fragments of neoplastic tissue in the sputum of patients with cancer of the lung has been observed for many years. While such an occurrence is rare and usually indicates far advanced disease, an occasional diagnosis of bronchogenic carcinoma has been made by embedding and sectioning the tumor tissue so obtained. Betschart in 1895 reported a case of bronchogenic carcinoma in which the diagnosis was made by section of tumor fragments present in the sputum and cited 3 previous reports of cases in the literature. Similar diagnoses based on gross particles or sputum section were subsequently reported by a number of investigators including Sauerbruch in 1908, Bezangon and de Jong in 1913, Fishberg in 1926, Weller in 1929, Sweany in 1934, Hill in 1934, Edwards in 1934 and Holinger and associates in 1945. The technique employed by these workers involved ordinary histologic exami-

nation of tumor fragments or sputum embedded and sectioned in the usual manner. In general the results were not considered of great value in the diagnosis of bronchogenic carcinoma.

The first report of the cytologic examination of sputum in a case of bronchogenic carcinoma was made by Hampeln (10) in 1887. He found large atypical epithelial cells in the sputum which he believed were diagnostic of carcinoma. His technique was simply the microscopic examination of unstained smears of fresh sputum. In a second paper in 1918 Hampeln (11) reported 25 cases of pulmonary cancer in 13 of which carcinoma cells were found in the sputum. Hampeln stressed the diagnostic importance of isolated neoplastic cells in contrast to other workers who held that a histologic section of an actual fragment of tissue was necessary for the diagnosis of carcinoma.

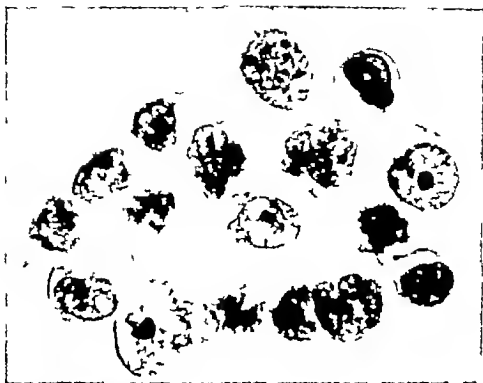
In spite of Hampeln's work, little attention was paid to the possibilities of cytologic study of sputum until the introduction of a new technique by Dudgeon and Wrigley of London in 1935. This method consisted essentially in

Abatement of thesis submitted by Dr. Woolner to the Faculty of the Graduate School of the University of Minnesota in partial fulfillment of the requirements for the degree of Master of Science in Pathology.

From the Section on Surgical Pathology, Mayo Clinic.

Fig. 4 (front piece) a. Clump of cells in sputum from a bronchogenic carcinoma of undifferentiated type. Note the large size of the cells, variation in size, nuclear-cytoplasmic ratio and prominent nucleoli (hematoxylin and eosin stain,  $\times 800$ ). b and c. Sputum smears from a keratinizing squamous cell bronchogenic carcinoma. Note voluminous eosin-

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b



c



d



Fig. 4

Cervical Cell Sp. 1 m. and B. 11 Secretions. A Study of 150 Consecutive Cases  
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(Legend on opposite page.)

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the making of films of fresh sputum fixing while wet in Schaudinn's solution and staining with hematoxylin and eosin. The basis for this new technique was the 'wet film' method of examination of fresh tissues described by Dudgeon and Patrick in 1927 and Dudgeon and Barrett in 1934. According to this procedure fresh tissues were scraped with a scalpel and the resulting suspension of cells transferred to a glass slide. Smears so obtained were fixed while wet in Schaudinn's fluid and stained with hematoxylin and eosin. By this means it was found possible to recognize malignant cells as such when separated from their usual surroundings. After eight years of experience with the wet film method in the study of fresh tissues Dudgeon and Wrigley employed the same technique to the study of sputum with equally successful results. In 68 per cent of 58 cases of proved carcinoma of the lung or respiratory tract malignant cells were demonstrated in the sputum. In the majority of cases these authors were able to predict the histologic type of growth present in the bronchus by a study of the sputum. One false positive result occurred in this series, the atypical cells arising in an inflammatory lesion.

Using a similar technique Barrett reported positive results in 68 of 110 proved cases of bronchogenic carcinoma while Gower obtained positive results in 64 per cent of 93 cases in which the sputum was investigated.

A very thorough study of the subject was reported by Waudall of Copenhagen in 1944. The material comprised 250 patients, 100 of whom had primary bronchogenic carcinoma. Of this group of 100 cases carcinoma cells were found in the sputum in 84. The technique used was that of Dudgeon and Wrigley in which Schaudinn's fixative and hematoxylin and eosin stains were used. Eighty-two of the 100 patients with bronchogenic carcinoma underwent bronchoscopy. Biopsy gave positive results in 55 per cent. Examination of the sputum in this group gave the higher figure of 82 per cent positive results. Combining both these methods Wandall found that a positive diagnosis of carcinoma could be made in 94 per cent of cases. Of 193 instances of sputum examination in which the clinical rec-

ord was entirely unknown a false positive result was given in 6, a percentile error of 3.1. Wandall concluded that a search for neoplastic cells in sputum should be introduced as an important link in the examination of patients believed to be suffering from primary bronchogenic carcinoma.

A study of bronchoscopically removed sections was carried out by Herbut and Clerf (12) in 1946. These authors expressed the belief that the examination of bronchial secretions is superior to the examination of sputum by reason of the increased dilution of the latter. Bronchoscopic removal of secretions from the region of the suspected tumor serves further to localize the source of the malignant cells. Positive results were obtained in 82.4 per cent of 57 proved cases of bronchogenic carcinoma. The results of bronchoscopic biopsy in this series were positive in 42 per cent. A positive diagnosis in 25 of their final 27 cases (92.5 per cent) led these authors (13) to conclude that in most cases of carcinoma of the lung the diagnosis can be made by means of cytologic study of bronchoscopically removed secretions.

Papanicolaou (16, 18, 19) for many years has stressed the value of the smear test as a basis for the diagnosis of malignant neoplasms having a free surface. While primarily concerned with cytologic study of vaginal secretions in the diagnosis of uterine cancer, he has reported results of sputum examination in 25 cases of carcinoma of the lung (17). In 22 of these cases (88 per cent) the sputum smears were positive for malignant cells. No false positive reports were given in this series.

#### PLAN OF THE PRESENT STUDY

The problems involved in this study were threefold: (1) to become familiar with the appearance of carcinoma cells in sputum and bronchial secretions as well as normal cells in all their variations, (2) to work out technical details of collection, smearing, fixation and staining of material and (3) to evaluate the method as a routine procedure to be used in the diagnosis of primary bronchogenic carcinoma. A preliminary period of study on sputum or secretions removed bronchoscopically from patients known to have carcinoma and from patients known not to have carcinoma



Fig. 1. Normal cells in sputum and bronchial secretions stained with hematoxylin and eosin. a. Squamous epithelial cells ( $\times 600$ ). b. Ciliated columnar epithelial cell ( $\times 600$ ). c. Pigmented macrophages ( $\times 440$ ).

was carried out. In addition smears were made from bronchial secretions of lungs removed surgically for bronchogenic carcinoma. In other instances the surface of the tumor itself was gently scraped and the resulting emulsion of cells smeared, fixed and examined. By this means familiarity with the appearance of carcinoma cells occurring apart from their normal environment was gradually acquired. Various methods of fixation and staining were tried to determine the best technique for routine laboratory work.

After this preliminary study specimens of sputum or bronchial secretions were studied as unknowns and positive or negative results were reported. In doubtful cases a second or even a third specimen was examined. In all sputum or bronchial secretions were examined for carcinoma cell from a total of 1,600 patients. In 150 of these cases results were reported as positive and in 1,450 they were considered negative. No follow-up studies were done on the group of patient for whom the results were negative but the vast majority were considered to have nonneoplastic lesion.

After positive results in 150 consecutive cases were reported the results were tabulated and analyzed.

#### TECHNIQUE

The methods of collection of specimens, preparations of smears, fixation and staining have been outlined in a previous report by the authors (24). The staining method used routinely is Harris hematoxylin with dilute eosin as a counterstain. It has proved entirely satisfactory for nuclear detail, the factor on which the diagnosis is primarily based, and has the advantage of familiarity to pathologists.

*Examination of smears.* Five smears from each specimen are fixed and stained according to the aforementioned technique. The films are then carefully scanned under low power, the high dry objective being used in study cell detail. It may be useful to mark suspicious cells or clumps with ink and later to return for careful consideration of these areas. The number of carcinoma cells per slide in a case of carcinoma varies considerably. In rare cases almost every low power field will show malignant cells. In many cases each slide will contain a few scattered clumps and isolated single cancer cells. Occasionally only one or two of the five slides will give positive result.

For this reason it is important that all slides in a given case be examined methodically, a mechanical stage being used if necessary. The

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A study of bronchoscopically removed sections was carried out by Herbut and Clerf (12) in 1946. These authors expressed the belief that the examination of bronchial secretions is superior to the examination of sputum by reason of the increased dilution of the latter. Bronchoscopic removal of secretions from the region of the suspected tumor serves further to localize the source of the malignant cells. Positive results were obtained in 82.4 per cent of 57 proved cases of bronchogenic carcinoma. The results of bronchoscopic biopsy in this series were positive in 42 per cent. A positive diagnosis in 25 of their final 27 cases (92.5 per cent) led these authors (13) to conclude that in most cases of carcinoma of the lung the diagnosis can be made by means of cytologic study of bronchoscopically removed secretions.

Papanicolaou (16, 18, 19) for many years has stressed the value of the smear test as a basis for the diagnosis of malignant neoplasms having a free surface. While primarily concerned with cytologic study of vaginal secretions in the diagnosis of uterine cancer, he has reported results of sputum examination in 25 cases of carcinoma of the lung (17). In 22 of these cases (88 per cent) the sputum smears were positive for malignant cells. No false positive reports were given in this series.

#### PLAN OF THE PRESENT STUDY

The problems involved in this study were threefold: (1) to become familiar with the appearance of carcinoma cells in sputum and bronchial secretions as well as normal cells in all their variations; (2) to work out technical details of collection, smearing, fixation and staining of material; and (3) to evaluate the method as a routine procedure to be used in the diagnosis of primary bronchogenic carcinoma. A preliminary period of study on sputum or secretions removed bronchoscopically from patients known to have carcinoma and from patients known not to have carcinoma

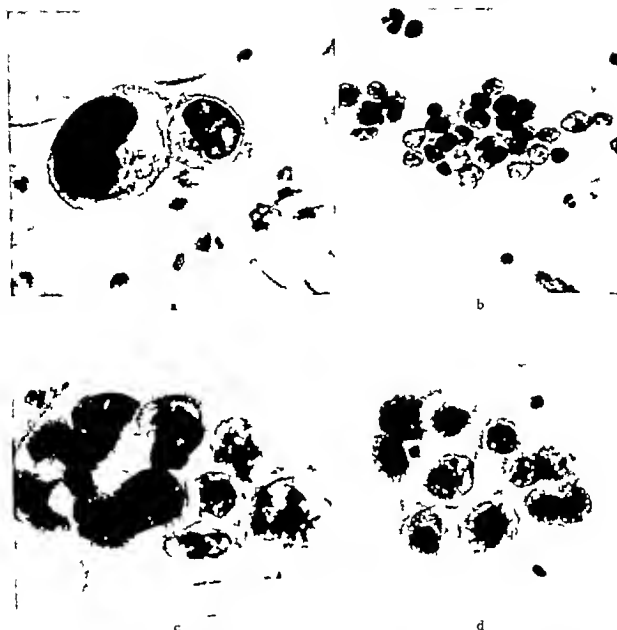


Fig. 2. Identification of exfoliated cancer cells in sputum or bronchial secretions (hematoxylin and eosin stain). a, Very large carcinoma cells in sputum. Compare size with that of adjacent polymorphonuclear leucocyte ( $\times 640$ ). b, Sputum from bronchogenic carcinoma of small cell "oat-cell" type. Note small size of carcinoma cells and variation in size of nuclei ( $\times 640$ ). c, Clump of carcinoma cells in sputum. Note variation in size of cells and mitotic figure ( $\times 640$ ). d, Clump of carcinoma cells in bronchial secretions. Note very large nucleoli ( $\times 640$ ).

pyema bronchitis bronchial asthma and congestive heart failure. Once familiarity is gained with the normal cells carcinoma cells because of their highly atypical appearance can be diagnosed with confidence and with a high degree of accuracy.

#### CARCINOMA CELLS IN SPUTUM AND BRONCHIAL SECRETIONS

*General characteristics of carcinoma cells.* Exfoliated cancer cells in sputum or bronchial

secretions possess certain distinctive features on which a diagnosis of malignancy can be safely based. In general it may be said that all the characteristic features of malignant cells seen in tissue sections with the exception of invasion can be applied to isolated cells singly and in clumps occurring in sputum and bronchial secretions. No single atypical feature is in itself diagnostic. The diagnosis is based on the complete cytologic picture in a given case in which the cells may present





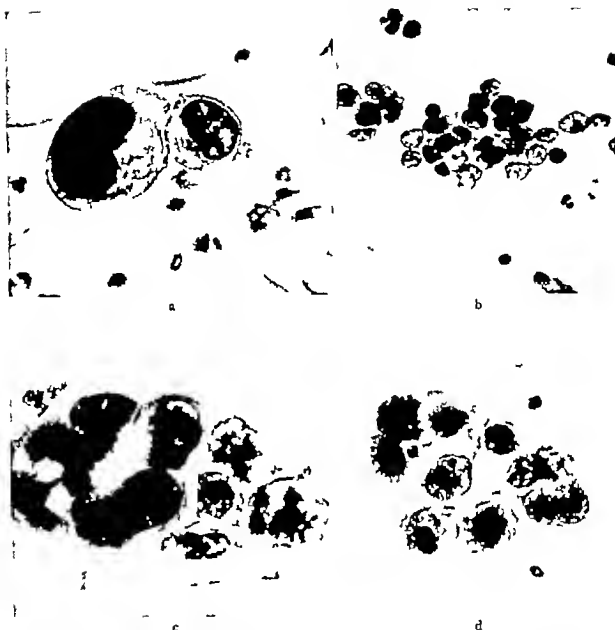


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any or all of the following atypical characteristics

**Size**—Carcinoma cells are in general much larger than the normal cells in sputum or bronchial secretions. In some cases, cells of such enormous nuclear dimensions can be found (Fig. 2a) as to preclude any possibility of error in the diagnosis of malignancy. In other instances the carcinoma cells while still large more nearly approach the size of normal cells and more reliance must be placed on other atypical features. In the small cell oat cell type of bronchogenic carcinoma the cells fall well within the range of size of normal cells the nucleus being only two or three times the diameter of a lymphocyte (Fig. 2b).

**Nuclear cytoplasmic ratio**—More important than the size of the cell itself is the size of the nucleus and the relation of nucleus to cytoplasm. In the malignant cell the nucleus is very large in relation to the amount of cytoplasm. In some highly undifferentiated tumors the relatively large nucleus is surrounded by a narrow rim of cytoplasm. In others as in the small cell carcinomas the carcinoma cell frequently appears as a naked nucleus. An exception to this general finding is seen in the cells of a keratinizing squamous cell carcinoma. Many of these cells show voluminous acidophilic cytoplasm indicating keratinization of individual cells.

**Variation in size and shape**—Variation in size and shape of the nuclei is an extremely important consideration. This can best be appreciated when small clumps or clusters of carcinoma cells are present (Fig. 2c). Small clumps of malignant cells are a frequent finding in smears and although not essential for a diagnosis of malignancy aid greatly in the case of interpretation. Clumps of benign cells present a regularity of size shape and staining of the nuclei not seen in neoplastic tissue. Variation in size and shape of the cells is probably least marked in small cell carcinomas, but even in this type sufficient variation is present to differentiate these cells from normal. In sputum or secretions from highly malignant tumors variation in cell size may be extreme and tumor giant cells may be seen.

**Variation in staining**—Carcinoma cells possess distinctive staining properties which are

as apparent in smears as in tissue sections. Nuclei of carcinoma cells generally are hyperchromatic and show a coarse chromatin network. In many cases carcinoma cells possess unusually large often multiple nucleoli of irregular shape and size (Fig. 2d). The nucleoli may appear basophilic or acidophilic and, when prominent, offer a definite aid in diagnosis. Details of nuclear structure are most important and for this reason a uniform and consistent staining technique must be developed. It should be noted that good nuclear detail may not be present in all atypical cells found in the smear. Careful search may be necessary to find well preserved cells with characteristic features on which a diagnosis of carcinoma may be safely based.

**Mitotic figures**.—In general cells undergoing mitosis are rarely found in smears of sputum or bronchial secretions and are of no importance in the diagnosis of carcinoma by this technique. Even in rapidly growing tumors as shown by tissue section mitotic figures are rarely found in the exfoliated cancer cells examined in the smear.

**Special characteristics of carcinoma cells according to histologic type**—Foliated cancer cells vary somewhat in appearance according to the histologic type of tumor present in the bronchus (Figs. 3, 4, frontispiece and 5). These tumors can be classified into four main groups: (1) small cell oat-cell carcinoma, (2) undifferentiated large cell carcinoma, (3) squamous cell carcinoma in which cell keratinization or pearly body formation is noted, and (4) adenocarcinoma characterized by the production of mucus or by gland formation. To these should be added so called alveolar cell carcinomas representing a small group of primary pulmonary neoplasms and presenting a characteristic gross and histologic pattern.

Carcinoma cells are found in the sputum in all these types and in certain instances are sufficiently distinctive to predict the histologic type of tumor in the bronchus. This is true especially of small cell carcinomas and keratinizing squamous cell carcinomas. In other cases especially in highly undifferentiated tumors, a diagnosis of carcinoma cells present is made without reference to type. Occasionally the problem arises as to whether a given

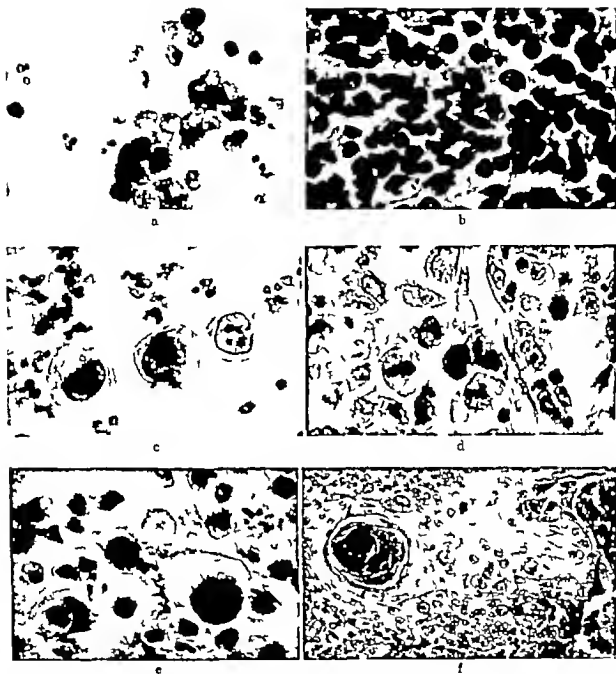


Fig. 3. Readily identified histologic types of exfoliated carcinoma cells in sputum (hematoxylin and eosin stain). a, Sputum smear from a bronchogenic carcinoma of small cell "oat-cell" type ( $\times 640$ ) and b, corresponding tissue section ( $\times 640$ ). Note similarity of cells. c, Carcinoma cells in sputum from an undifferentiated large cell bronchogenic carcinoma showing large nuclei and prominent nucleoli ( $\times 640$ ) and d, corresponding tissue section ( $\times 640$ ). e, Smear from bronchogenic carcinoma of squamous type showing large amount of cytoplasm and, f, tissue section of keratinizing squamous cell carcinoma ( $\times 165$ ).

pulmonary tumor is primary or metastatic. The presence of small 'oat-cell' or squamous carcinoma cells may in such cases aid in establishing a diagnosis of primary bronchogenic carcinoma. If the malignant cells in the sputum possess no distinctive features the primary or secondary nature of the tumor must be assessed in the light of the whole clinical picture.

**Small cell bronchogenic carcinoma.**—Exfoliated carcinoma cells from a small cell bronchogenic carcinoma are readily detected by the smear technique. The cells are small in size as compared with carcinoma cells of other types but nevertheless stand out prominently under the low power objective, frequently in clusters or streaks across the slide. Occurring in this fashion they are readily detected under

low magnification whereas a single cell might escape notice. Under the high power objective the main features of note are the small size of the cells, the virtual absence of cytoplasm and the hyperchromatism of the nuclei (Fig. 3a). Definite variation in size of the nuclei from cell to cell is a very important criterion in diagnosis. The nuclear chromatin forms a coarse network. Nucleoli are usually not prominent in carcinoma cells of this type. The appearance of the cells in tissue sections of this type of bronchogenic carcinoma is shown in Figure 3b.

**Undifferentiated bronchogenic carcinoma.**—Carcinoma cells in sputum from an undifferentiated bronchogenic carcinoma with corresponding tissue section are shown in Figure 3c and d. In such cases the carcinoma cells are large with marked variation in size and shape of the nuclei. The nucleus is large in relation to the cytoplasm, is hyperchromatic and contains prominent nucleoli. Cells of this type occurring singly as shown here provide adequate evidence for a diagnosis of carcinoma. Clumps of carcinoma cells although not essential aid greatly in the case of diagnosis. A clump of cells from an undifferentiated bronchogenic carcinoma is shown in Figure 4a. These cells exhibit all the characteristics of malignancy seen in a tissue section (except invasion) including large size, marked variation in size and shape of nuclei, hyperchromatism and very large nucleoli.

**Squamous cell carcinoma.**—Exfoliated cancer cells from a squamous cell bronchogenic carcinoma are shown in Figure 3e and a corresponding tissue section is shown in Figure 3f. In this type the carcinoma cells are large with irregularity in size and shape of the nuclei. The cytoplasm is frequently abundant and is deeply eosinophilic depending on the degree of keratinization of the cells (Fig. 4b). Inclusion of one cell in another suggestive of a beginning whorl or cell nest is a rather frequent finding (Fig. 4c). As is true of small cell carcinoma, the cytologic characteristics of sputum from a patient with a keratinizing squamous cell carcinoma is usually distinctive enough to predict accurately the histologic type of tumor to be found in the bronchus.

**Adenocarcinoma.**—In Figure 5a is shown a clump of neoplastic cells in a bronchial aspiration which exhibit a tendency toward an acinar arrangement. The tissue section in this case revealed an adenocarcinoma of the bronchus (Fig. 5b). The occurrence of such a large fragment of tissue showing a glandular arrangement is distinctly unusual in sputum or bronchial secretions. Occasionally however an abnormal vacuolation of the cytoplasm indicating the production of mucus points to a diagnosis of adenocarcinoma. In most cases of adenocarcinoma a diagnosis of carcinoma cells present is made without any indication of type.

**Alveolar cell carcinoma.**—In 2 cases in this series atypical cells were found in the sputum and the roentgenologic appearances were those of alveolar cell carcinoma involving both lungs. No tissue was obtained in either of these cases. In a third case one lobe only was involved. The sputum contained carcinoma cells (Fig. 5c). Bronchoscopic examination gave negative results. The excised lobe was diffusely involved with alveolar cell carcinoma (Fig. 5d).

**Metastatic tumor of the lung.**—In a few cases in this series, carcinoma cells in the sputum were probably of metastatic origin. In 1 instance bronchial secretions contained large plaques of tumor cells of undifferentiated type. A tumor of the testis had been removed 2 years previously and the growth in the lungs was presumably metastatic. In 1 case the bowel and in another the ovary were considered the primary sources of the tumors. Differentiation of primary from secondary tumor of the lung is usually impossible on the basis of smears although the presence of oat cells or squamous carcinoma cells in the sputum represents fairly good evidence of a primary bronchogenic carcinoma.

#### ANALYSIS OF CASES

This study is based on 150 cases in which carcinoma cells were found in sputum or bronchial secretions. It does not represent the findings in a consecutive series of 150 bronchogenic carcinomas. An exact statistical study was not attempted since secretion or sputum was not available in all cases and in

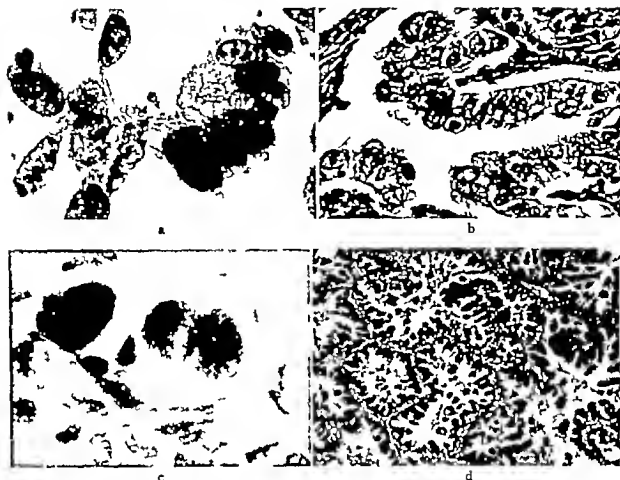


Fig. 5. Adenocarcinoma of the bronchus and alveolar cell carcinoma of the lung (hematoxylin and eosin stain). a, Carcinoma cells in bronchial secretions from a bronchogenic carcinoma of the adenocarcinoma type showing suggestion of gland formation ( $\times 640$ ) and b, tissue section from same lesion ( $\times 395$ ). c, Carcinoma cells in bronchial secretions ( $\times 640$ ) and, d, tissue section from an alveolar cell carcinoma of the lung ( $\times 65$ ).

some instances the material submitted for examination was inadequate. The method of study adopted was to collect 150 cases in which sputum or bronchial secretion was positive for carcinoma cells and by an analysis of these cases to evaluate the accuracy of the method and its usefulness as a routine diagnostic procedure.

**Source of carcinoma cells in sputum.** The majority of cases in this series represented proved or suspected bronchogenic carcinoma. In 146 of 150 cases the source of the malignant cells was believed to be a tumor of the bronchus. Carcinoma cells however may appear in the sputum from a malignant lesion anywhere in the respiratory tract pharynx or esophagus. In 2 cases in this series the sputum contained malignant cells arising from an esophageal carcinoma. In both a tracheoesophageal fistula was demonstrated and the na-

ture of the lesion proved by biopsy. In 1 case the trachea and in another the larynx were found to be the source of the carcinoma cells found in the sputum. The latter patient gave a history of several months hoarseness with recent slight hemoptysis. Biopsy revealed a squamous cell carcinoma of the larynx. One disadvantage of sputum examination is this failure to localize the lesion. In contrast to examination of sputum examination of bronchial secretions has the advantage that the source of the malignant cells particularly the side involved can be more accurately determined.

**Comparison of sputum and bronchial secretions.** A comparison of sputum and bronchial secretions as a source of carcinoma cells reveals no essential advantage of one over the other. In a given case of bronchogenic carcinoma the specimen of sputum submitted may

occasionally be negative for carcinoma cells while the bronchoscopically removed secretions prove positive. This was found to be true in 10 cases of a total of 110 cases of bronchogenic carcinoma in which the sputum was examined. The reverse (sputum positive and bronchial secretions negative for carcinoma cells) was found to be true in 6 of 80 cases in which bronchial secretions were examined. A negative result on sputum examination in a case believed clinically to be carcinoma should be followed by a second and if necessary a third sputum examination. This assures an adequate sampling of the sputum and greatly reduces the possibility of a false negative report. If bronchial secretions submitted in a suspected case of bronchogenic carcinoma are negative for carcinoma cells subsequent examination of the sputum should be carried out. If the results of sputum examination prove positive while the results of examination of bronchial secretions are negative it is assumed that the secretions were not aspirated from the bronchus involved by the carcinoma. Both methods of examination should be utilized whenever possible.

*Accuracy of diagnosis.* In this series of 146 cases of suspected pulmonary neoplasm a final diagnosis of primary bronchogenic carcinoma was established by bronchoscopic biopsy in 64 cases and by surgical exploration in 24 cases. In 2 additional cases in which the results of bronchoscopic biopsy were positive the pulmonary lesion was considered metastatic. Autopsy biopsy of supraclavicular nodes punch biopsy and section of expectorated tissue provided proof of the diagnosis in 7 cases. In 3 cases a false positive report was given on the basis of the findings in the smears; the absence of carcinoma was proved in 2 of these cases at operation and in 1 at necropsy. In the remaining 46 cases carcinoma was not proved by tissue section since tissue was not available. In all 46 cases carcinoma cells were found in the sputum or bronchial secretions. All patients presented symptoms related to the chest and evidence of carcinoma on roentgenologic examination of the lungs.

In 22 of these 46 cases additional evidence of bronchogenic carcinoma was presented in

the finding of clinical or roentgenologic evidence of metastasis. In 8 additional cases a tumor was visualized by the bronchoscopist although positive results at biopsy were not obtained. In 11 cases a diagnosis of inoperable bronchogenic carcinoma was made on the basis of history, clinical findings and roentgenologic evidence in the chest supported by demonstration of carcinoma cells in the sputum. In 1 case the final diagnosis was primary bronchogenic carcinoma or ovarian carcinoma with metastasis to the lungs. In 2 cases the disease was diagnosed alveolar cell carcinoma or metastatic malignant lesions to both lungs. In 1 case of long standing pulmonary suppurative disease roentgenologic findings in the chest were those of extensive cavitation of the upper third of both pulmonary fields. Sputum studies for acid fast bacilli gave negative results but cytologic studies showed numerous carcinoma cells present. Bronchoscopy failed to locate any malignant process. No follow-up on this patient was available. In 1 case the final diagnosis was empyema or bronchogenic carcinoma and no further information could be secured. In all cases except the last 2 the diagnosis of a malignant process in the lung was considered to be beyond doubt. All lesions were considered inoperable or operation was recommended and refused. In the last 2 cases the clinical impression favored a nonmalignant process but atypical cells were found in the sputum smears.

In review of 150 cases in which the smears were reported positive for carcinoma cells, in 145 there was a final diagnosis of carcinoma, in 3 cases the final diagnosis was disease other than carcinoma (proved false positive reports) and the final diagnosis in 2 cases was not established.

*Value of the method as an adjunct to established methods of diagnosis.* This study indicates that the cytologic study of sputum and bronchial secretion is a valuable adjunct in the diagnosis of bronchogenic carcinoma. Of the 146 patients with suspected bronchogenic carcinoma 114 were examined bronchoscopically. In this group a specimen for biopsy was obtained in 97 cases and the results of biopsy were positive for carcinoma in 66 cases. Thus, of the group of 114 cases in which bron-

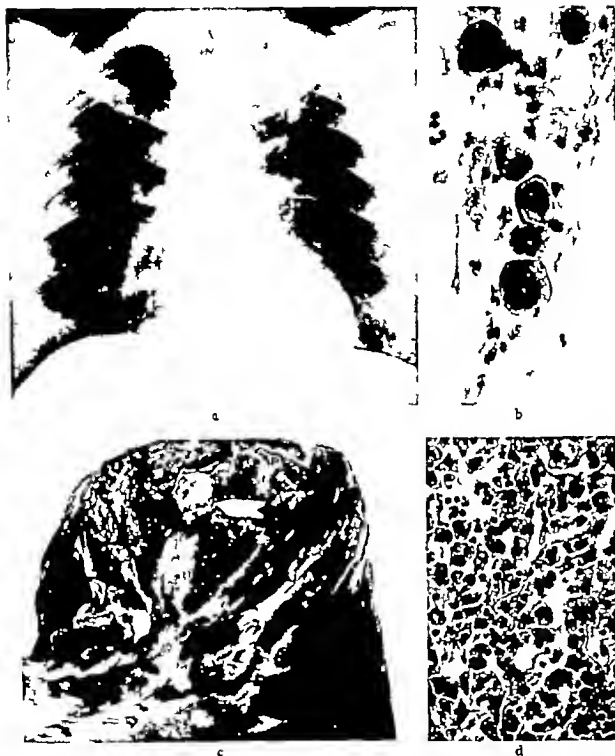


Fig 6 Case 1. Peripherally located bronchogenic carcinoma. Lung removed surgically on basis of a, roentgenologic shadow and, b, carcinoma cells in sputum (hematoxylin and eosin stain  $\times 640$ ). c, Lesion indicated by arrow. d, Tissue section (hematoxylin and eosin stain  $\times 300$ ).

choscopy was performed cytologic studies on sputum or bronchial secretions provided the only microscopic basis for a diagnosis of carcinoma in 48 cases (42 per cent).

Surgical exploration was carried out in 58 cases in this series. In 31 of these the results of preoperative bronchoscopic biopsy were

positive while in 25 cases bronchoscopic biopsy could not be performed or the results were negative. Positive results on examination of smears of sputum or bronchial secretions however provided a preoperative diagnosis of carcinoma. In this group two of the three false positive diagnoses were made. In



occasionally be negative for carcinoma cells while the bronchoscopically removed secretions prove positive. This was found to be true in 10 cases of a total of 110 cases of bronchogenic carcinoma in which the sputum was examined. The reverse (sputum positive and bronchial secretions negative for carcinoma cells) was found to be true in 6 of 80 cases in which bronchial secretions were examined. A negative result on sputum examination in a case believed clinically to be carcinoma should be followed by a second and if necessary a third sputum examination. This assures an adequate sampling of the sputum and greatly reduces the possibility of a false negative report. If bronchial secretions submitted in a suspected case of bronchogenic carcinoma are negative for carcinoma cells, subsequent examination of the sputum should be carried out. If the results of sputum examination prove positive while the results of examination of bronchial secretions are negative it is assumed that the secretions were not aspirated from the bronchus involved by the carcinoma. Both methods of examination should be utilized whenever possible.

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the finding of clinical or roentgenologic evidence of metastasis. In 8 additional cases a tumor was visualized by the bronchoscope although positive results at biopsy were not obtained. In 11 cases a diagnosis of inoperable bronchogenic carcinoma was made on the basis of history, clinical findings, and roentgenologic evidence in the chest supported by demonstration of carcinoma cells in the sputum. In 1 case the final diagnosis was primary bronchogenic carcinoma or ovarian carcinoma with metastasis to the lungs. In 2 cases the disease was diagnosed alveolar cell carcinoma or metastatic malignant lesions to both lungs. In 1 case of long standing pulmonary supportive disease roentgenologic findings in the chest were those of extensive cavitation of the upper third of both pulmonary fields. Sputum studies for acid fast bacilli gave negative results but cytologic studies showed numerous carcinoma cells present. Bronchoscopy failed to locate any malignant process. No follow up on this patient was available. In 1 case the final diagnosis was emphysema or bronchogenic carcinoma and no further information could be secured. In all cases except the last 2 the diagnosis of a malignant process in the lung was considered to be beyond doubt. All lesions were considered inoperable or operation was recommended and refused. In the last 2 cases the clinical impression favored a nonmalignant process but atypical cells were found in the sputum smears.

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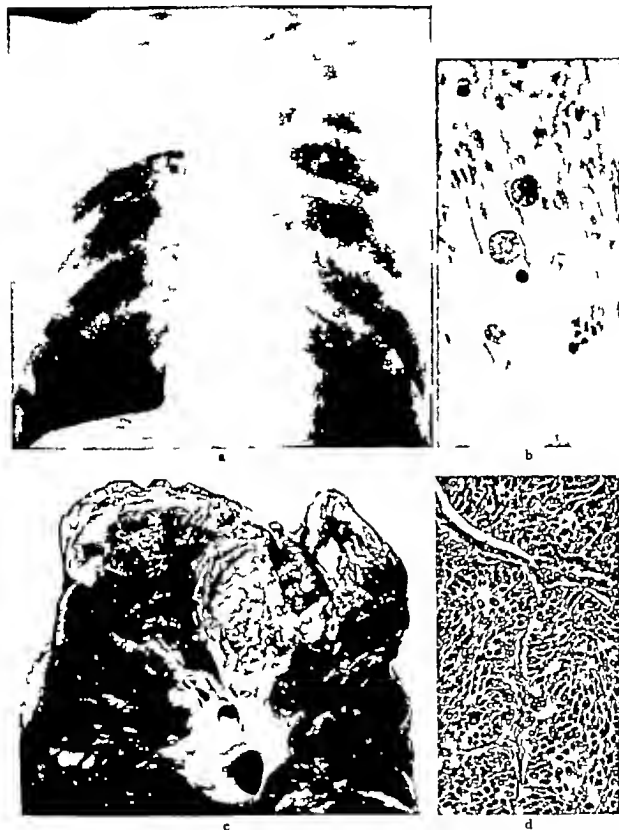


Fig. 7. Case 2. Bronchogenic carcinoma of the upper lobe. Lesion in the upper lobe inaccessible for the purpose of bronchoscopic biopsy. a, Roentgenologic appearance. b, Carcinoma cells in sputum (hematoxylin and eosin stain  $\times 640$ ). c, Gross lesion. d, Tissue section (hematoxylin and eosin stain  $\times 130$ ).

has been acquired. Errors at this stage are the result of inexperience of the examiner rather than a result of deficiencies of the method.

After familiarity with the method has been gained, diagnosis by means of smears becomes accurate and reliable.

1 case bronchoscopic examination revealed a tumor projecting from the upper lobe bronchus. Bronchial secretions contained atypical cells interpreted as carcinomatous. Lobectomy revealed stenosis of the upper lobe bronchus with multiple lesions of caseous tuberculosis throughout the lobe. In the second case bronchoscopic examination showed obstruction of the right middle lobe bronchus. Lobectomy was carried out and diffuse bronchiectasis was found in the middle and lower lobes. In the remaining 56 cases in this group bronchogenic carcinoma was demonstrated at operation. In 24 of these cases the lesion proved to be removable. Pneumonectomy or lobectomy for bronchogenic carcinoma was performed on the basis of positive results of bronchoscopic biopsy in 15 of the 24 cases. In 9 cases bronchoscopic biopsy gave negative results or could not be performed and a preoperative diagnosis of carcinoma was based on the cytologic characteristics of the sputum or bronchial secretions. Of the 9 bronchogenic carcinomas excised on a basis of positive cytologic findings 5 were situated in the upper lobes, 1 in the right middle lobe, 2 in the lower lobes and 1 proved to be an alveolar cell carcinoma diffusely involving the whole left lower lobe of the lung.

*Lesions of the upper lobe.* Because of the inaccessibility of many upper lobe lesions for bronchoscopic biopsy, study of smears of sputum or bronchial secretions provides an especially useful adjunct to diagnosis. In this group, in 19 cases of this series the site of the lesion could not be accurately located. In 41 or almost a third of the remaining cases the lesion was situated in the upper lobes. Diagnosis of bronchogenic carcinoma was established by bronchoscopic biopsy in 12 of these 41 cases. Cytologic diagnosis of carcinoma on the basis of sputum or bronchial secretions was confirmed by surgical exploration in 14 cases and by autopsy, punch biopsy, or lymph node biopsy in 3 additional cases. In 12 cases the dismissal diagnosis was bronchogenic carcinoma, inoperable. In 3 of these 12 cases roentgenologic or clinical evidence of metastasis was present.

*Inoperable lesions in the diagnosis of which a bronchoscopic examination is not indicated.* In

32 cases of suspected bronchogenic carcinoma, a bronchoscopic examination was not carried out. In these cases roentgenologic or clinical evidence of metastasis, pleural effusion, or other signs of inoperability were presented. In such cases sputum examination provides a convenient method of confirming the clinical diagnosis of bronchogenic carcinoma. A sputum examination the results of which are negative or inconclusive in the face of good clinical evidence of carcinoma should be repeated several times if necessary. In 1 case in this series carcinoma cells were found in the fourth specimen of sputum examined. The diagnostic importance to be attached to negative results on examination of sputum or bronchial secretion depends on the situation of the lesion. In general a hilar lesion associated with repeatedly negative results on sputum examination is almost certainly not carcinoma. A very peripherally located bronchogenic carcinoma may or may not be associated with malignant cells in the sputum depending on the accessibility of the desquamated cells to the bronchial tree.

*False positive results of examination of sputum or bronchial secretions.* In this series a false positive report on the basis of smears was given in 3 cases. In 2 additional cases the final diagnosis was not established. In 2 of the 3 cases in which proved false positive results were obtained lobectomy was performed. In 1 case bronchial stenosis and caseous tuberculosis were found. In the second, bronchiectasis of the middle and lower lobes was present. In the third case roentgenograms of the lungs revealed a diffuse process in the bases of both lungs which was believed to be inflammatory. Cytologic examination of the sputum disclosed atypical cells interpreted as carcinoma cells. At autopsy extensive pulmonary infarction was found in addition to an organized pneumonic process in both lungs. The mucosa of the large bronchi was the site of equamous metaplasia and marked epithelial proliferation, with numerous mitotic figures in the hyperplastic epithelial cells.

Erroneous diagnoses may occur with this technique in the early period of investigation before sufficient experience with the method

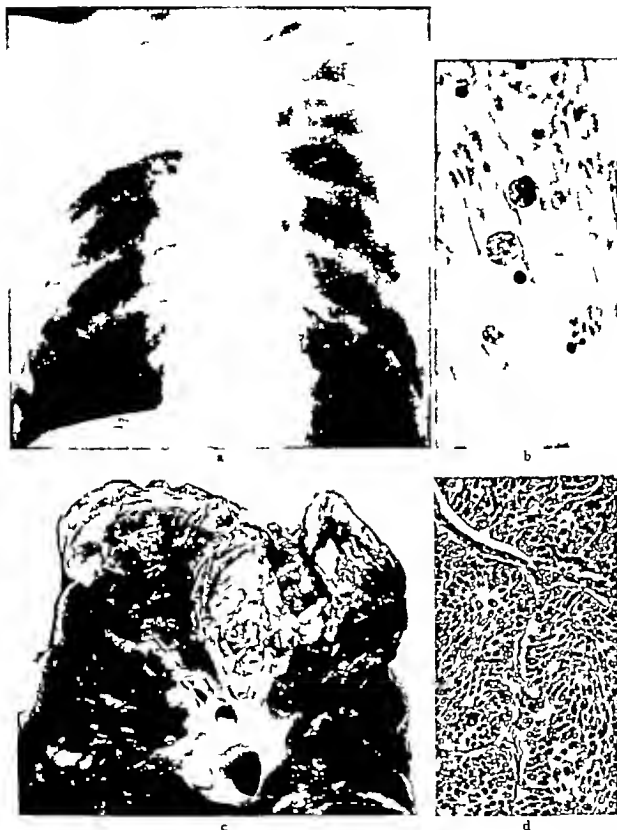


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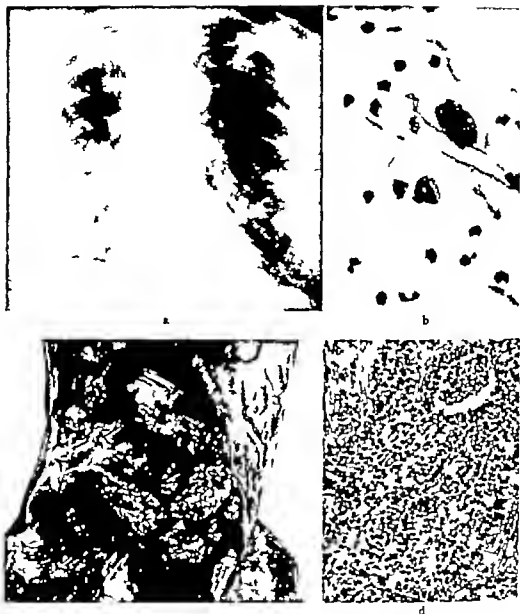


Fig 8. Case 3. Bronchogenic carcinoma of the middle lobe. Diagnosis based on carcinoma cells in sputum. a, Roentgenologic appearance. b, Carcinoma cells in sputum (hematoxylin and eosin stain  $\times 640$ ). c, Gross lesion. d, Tissue section (hematoxylin and eosin stain  $\times 30$ ).

#### REPORT OF ILLUSTRATIVE CASES

**CASE.** *Peripheral bronchogenic carcinoma.* A 39-year-old white man complained of fever, malaise, night sweats, and weight loss of 1 month duration. Symptoms relating to his chest were minimal consisting of slight hemoptysis and pain in the left axilla for 3 days before admission. Results of roentgenologic examination of the chest (Fig. 6a) were reported as follows: Pathologic process left apex, probably tuberculous but rule out primary malignancy. Bronchoscopic examination gave negative results. The sputum was negative for acid-fast bacilli and fungi. Clinically the picture did not suggest malignancy but had many features of an infectious process. The skin test and serum agglutination test were positive but blood cultures were negative for Brucella. The problem was solved by a cytologic examination of sputum which showed carcinoma cells (Fig. 6b). The lung was resected and small lesion was found in the apex (Fig. 6c) measuring less than 2 centimeters in diameter. In sputum

negative. Bronchoscopic examination gave negative results. The sputum was negative for acid-fast bacilli and fungi. Clinically the picture did not suggest malignancy but had many features of an infectious process. The skin test and serum agglutination test were positive but blood cultures were negative for Brucella. The problem was solved by a cytologic examination of sputum which showed carcinoma cells (Fig. 6b). The lung was resected and small lesion was found in the apex (Fig. 6c) measuring less than 2 centimeters in diameter. In sputum

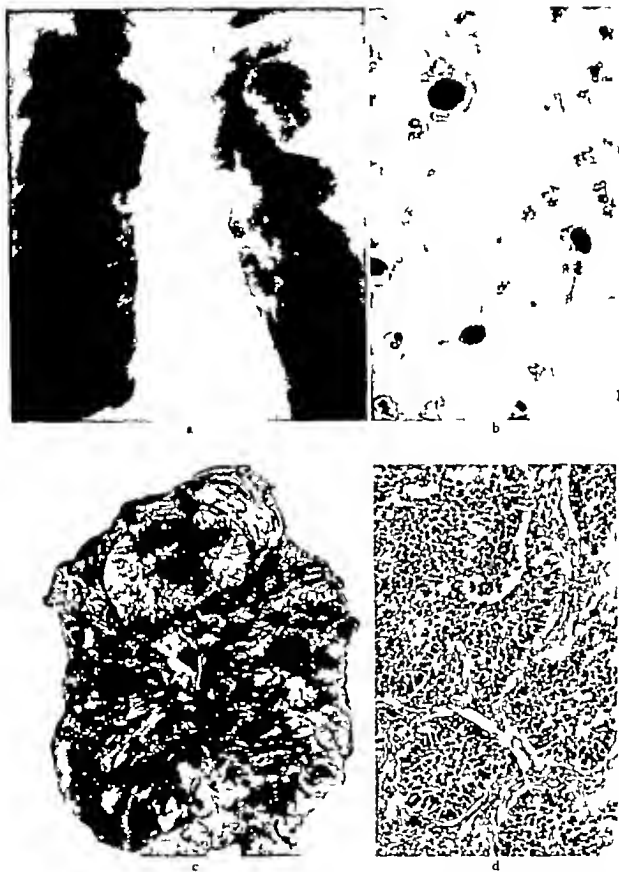


Fig. 9. Case 4. Carcinoma in a bronchogenic cyst. Finding of carcinoma cells in sputum provided a preoperative diagnosis of carcinoma. a. Roentgenologic appearance. b. Carcinoma cells in sputum (hematoxylin and eosin stain  $\times 650$ ). c. Gross lesion. d. Tissue section (hematoxylin and eosin stain  $\times 130$ ).

of its very peripheral location large numbers of carcinoma cells were being discharged in the sputum. Histologically the tumor was a highly undifferentiated bronchogenic carcinoma (Fig. 6d).

**CASE 3. Branchogenic carcinoma of the upper lobe.** A 56 year old man registered at the clinic because of pain in the right side of the chest and cough of about 4 months duration. Roentgenograms of the chest revealed a mass in the posterior segment of the right upper lobe bronchogenic carcinoma to be ruled out (Fig. 7a). Bronchoscopy was carried out with the following report: "I was unable to get out far enough in the right upper lobe bronchus to visualize a growth. The right upper lobe bronchus seemed to be fixed. Specimen for biopsy could not be obtained. Sputum was negative for acid fast bacilli and fungi but was found to contain many carcinoma cells (Fig. 7b). A right pneumonectomy was performed and pathologic examination disclosed a bronchogenic carcinoma 3 centimeters in diameter involving the bronchus of the right upper lobe (Fig. 7c). Tissue section revealed a squamous cell carcinoma (Fig. 7d). No involvement of the lymph nodes was found.

**CASE 3. Peripheral bronchogenic carcinoma of the right middle lobe.** A 71 year old woman complained of a chronic dry cough of 8 months duration. The patient had had a cough each winter for several years which cleared up each time after the cold weather. Nine months before admission she had had an episode of pain in the lower part of the right side of the chest which extended up under the right scapula. No hemoptysis was noted at any time. The patient felt well and had gained weight. Roentgenograms of the chest (Fig. 8a) revealed thickened pleura with residual fibrosis in the right base. Sputum studies were negative for acid-fast bacilli but cytologic studies were positive for carcinoma cells (Fig. 8b). A bronchoscopic examination was carried out with the following report: "I was unable to visualize any tumor in the right lower lobe." Surgical exploration was done on the basis of the sputum findings and a tumor of the right lung was palpated. Because of the patient's age the surgeon elected to do a middle and lower lobe lobectomy. Pathologic examination revealed a small bronchogenic carcinoma involving one of the bronchi of the right middle lobe (Fig. 8c). Histologic section showed a squamous cell carcinoma (Fig. 8d). The patient had an excellent postoperative course and was discharged in good condition.

**CASE 4. Carcinoma in a bronchogenic cyst.** A 54 year old white man was admitted to the clinic because of cough, pain in the chest, and hemoptysis of 3 months duration. For the past 6 to 8 months he had noted listlessness, loss of 10 pounds (4.5 kgm.), occasional fever and night sweats. His past history revealed several attacks of pneumonia and pleurisy. Sputum examination for acid-fast bacilli and tuberculin skin tests gave negative results. Results of roentgenologic examination of the chest (Fig. 9a) were reported as follows: "There is a large, rather

well circumscribed cavity in the left upper lobe without a great deal of surrounding reaction. Some fibrosis in left apex. Rule out bronchogenic carcinoma with cavitation." The story of respiratory difficulty of long duration and the roentgenologic appearance of the lesion strongly suggested a bronchogenic cyst. However an examination of the sputum revealed carcinoma cells in great numbers (Fig. 9b). A bronchoscopic examination was not carried out. The preoperative diagnosis was carcinoma of the left upper lobe with cavitation. A left pneumonectomy was performed and the pathologic examination of tissue removed revealed a squamous cell carcinoma 4 by 3 by 2 centimeters in the wall of a bronchogenic cyst 6 centimeters in diameter (Fig. 9c). Histologic section (Fig. 9d) showed a squamous cell carcinoma. No lymph nodes were found involved. One small bronchus opened into the cyst, providing a pathway for the carcinoma cells to reach the sputum. The postoperative course was uneventful.

#### COMMENT

This study would indicate that cytologic examination of sputum and bronchial secretions is an extremely valuable adjunct in the diagnosis of carcinoma of the lung. Carcinoma cells may be distinguished from normal cells in the smear by a variety of atypical features including large size, variation in size and shape particularly of the nuclei, hyperchromatism and large nucleoli. A high degree of accuracy of diagnosis may be accomplished by this method as is shown by the occurrence of only 3 proved false positive reports in 150 cases in which a diagnosis of carcinoma was made by the smear technique.

The interpretation of smears requires considerable experience but, once this is gained, the test has great practical value. In practice a microscopic diagnosis of carcinoma is frequently established within an hour of receiving the specimen at the laboratory. It provides microscopic evidence of malignancy in many cases in which proof is otherwise not obtainable.

Many bronchogenic carcinomas particularly lesions of the upper lobe and peripherally located neoplasms are not accessible for bronchoscopic biopsy. In this series 124 patients underwent bronchoscopic examination. In 17 of these material for biopsy could not be obtained. In 31 cases the tissue removed for biopsy proved to be nonneoplastic while in the remaining 66 cases a microscopic diagno-

sis of bronchogenic carcinoma was made on the tissue removed. Obviously any method which would serve to supplement bronchoscopic examination and provide microscopic proof of the presence of carcinoma when biopsy cannot be performed would be of immense practical importance in the diagnosis of pulmonary neoplasms. It has been shown that cytologic study of sputum and bronchoscopically removed secretions provides this microscopic proof in the majority of these in accessible lesions. By combining both methods in the examination of the patient with suspected bronchial carcinoma a much higher rate of positive diagnoses can be accomplished than heretofore has been the case.

The ability to make a microscopically proved diagnosis of cancer in a higher percentage of cases will serve to reduce materially the preoperative diagnosis of indeterminate pulmonary lesion. In this series exploration for bronchogenic carcinoma was carried out in a total of 58 cases. Of this number 10 (31 or 53.4 per cent) carcinoma was diagnosed on the basis of bronchoscopic biopsy. In 25 cases cancer cells in the sputum or secretions provided the only microscopic evidence of malignancy. In 2 cases a false positive diagnosis was given on the basis of smears.

Furthermore by use of the smear technique a positive microscopic diagnosis of carcinoma may be made in many cases of suspected bronchogenic carcinoma in which a bronchoscopic examination is not indicated. In 32 cases no bronchoscopic examination was carried out. The demonstration of carcinoma cells in the sputum in these cases was a valuable confirmation of the clinical and roentgenologic evidence of primary bronchogenic carcinoma.

The need for earlier diagnosis of cancer of the lung is shown by the low rate of resectability of these lesions. In this series 24 bronchogenic carcinomas were removed in a total of 143 cases of suspected malignant disease. More widespread use of cytologic examination of sputum for cancer cells offers a hope of earlier detection of bronchogenic carcinoma before the lesion has progressed to an inoperable stage. Because of the vital importance of earlier diagnosis it is felt that every patient with an undiagnosed lesion of the chest

should be given the benefit of a carefully conducted cytologic examination of sputum or bronchial secretions for cancer cells.

#### SUMMARY

The purpose of this study was the identification of cancer cells in sputum or bronchial secretions and evaluation of the smear technique as a routine procedure in the diagnosis of bronchogenic carcinoma.

The technique employed was based on the original work of Dudgeon and Wrigley. Sputum was examined while fresh or it was collected in a few cubic centimeters of 95 per cent alcohol. Five smears were made from each specimen. The smears were fixed while wet in equal parts of absolute alcohol and ether for 30 minutes. The staining method adopted was Harris hematoxylin followed by dilute eosin as a counterstain.

Smears of sputum or bronchial secretions from nonneoplastic diseases of the lung revealed squamous and ciliated columnar epithelial cells, macrophages and various inflammatory cells.

Carcinoma cells in smears could be distinguished from normal cells by numerous atypical characteristics including large size, variation in size and shape of the cells and of the nucleus, the nuclear-cytoplasmic ratio, hyperchromatism of the nucleus and the presence of large nucleoli.

The appearance of carcinoma cells in sputum and bronchial secretions varies with the histologic type of tumor in the bronchus. Cancer cells originating in a bronchogenic carcinoma of small cell, oat-cell type or in a keratinizing squamous cell type provide the most distinctive morphologic characteristics. A diagnosis of the histologic type of tumor present was usually possible in the case of these two cell types. In most other bronchogenic carcinomas, especially the more undifferentiated tumors, a diagnosis of carcinoma cells present was made without reference to histologic type.

Metastatic lesions of the lungs may be the source of carcinoma cells in sputum or bronchial secretions.

Analysis of 150 cases in which the smears were diagnosed positive for carcinoma cells



of its very peripheral location large numbers of carcinoma cells were being discharged in the sputum. Histologically the tumor was a highly undifferentiated bronchogenic carcinoma (Fig. 6d).

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**CASE 3. Peripheral bronchogenic carcinoma of the right middle lobe.** A 71 year old woman complained of a chronic dry cough 18 months duration. The patient had had a cough each winter for several years which cleared up each time after the cold weather. Nine months before admission she had had an episode of pain in the lower part of the right side of the chest which extended up under the right scapula. No hemoptysis was noted at any time. The patient felt well and had gained weight. Roentgenograms of the chest (Fig. 8a) revealed "thickened pleura with residual fibrosis in the right base. Sputum studies were negative for acid fast bacilli but cytologic studies were positive for carcinoma cells (Fig. 8b). A bronchoscopic examination was carried out with the following report: "I was unable to visualize any tumor in the right lower lobe. Surgical exploration was done on the basis of the sputum findings and a tumor of the right lung was palpated. Because of the patient's age, the surgeon elected to do a middle and lower lobe lobectomy. Pathologic examination revealed a small bronchogenic carcinoma involving one of the bronchi of the right middle lobe (Fig. 8c). Histologic section showed a squamous cell carcinoma (Fig. 8d). The patient had an excellent postoperative course and was dismissed in good condition."

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**H**ORMONAL therapy is a recognized method of control of remote lesions in carcinoma of the female breast (2). The clinical response is not uniform and various factors have been cited as influencing the prognosticated response. Thus Nathanson states in regard to stilbestrol that favorable responses are confined to older women and that in younger women the disease is unaltered or perhaps accelerated. Halberstaedter and Hochman report that typical adenocarcinomas are more susceptible to treatment with estrogens than are anaplastic tumors. Their conclusion, however, is based on pathologic reports with no uniform terminology and no attempt at detailed grading. For these reasons it seems of interest to correlate histologic evidence of growth rate (and by inference physiologic maturity) with the observed response to physiologic modes of treatment.

## MATERIAL AND METHODS

Clinical material and therapeutic methods are described in a report by one of the authors (HLS 8). All cases of this report in which histologic material was available are included here. These cases, 27 in all, 17 treated with estrogens and 10 with testosterone, are summarized in Tables I and II.

Without being aware of the clinical data one of us (EL) reviewed all of the sections and graded the tumor according to the criteria

shown by Greenough to be of prognostic worth. This author has shown the following five points to be evidence of low malignancy: (1) marked adenomatous pattern, (2) marked secretion by cells, (3) uniformity of cell appearance and size, (4) uniformity of nuclear size, and (5) lack of nuclear hyperchromatism and of mitotic figures. Accordingly the maximum of each category was given the grading four plus and the minimum zero, the five averaged and the tumor assigned to an arbitrary group: low malignancy, three plus or over; medium, two plus; and high, one plus or less—using the nearest whole figure. This material is summarized with the clinical data in Tables I and II. Examples of each of these groups are shown in Figures 1 to 6.

## RESULTS

The large percentage of tumors of high malignancy in this series does not represent carcinomas of the breast in general; those of lower grades are probably cured by radical surgery. Thus this represents a distortion. However, in this series, although most carcinomas in younger age groups are highly malignant, the reverse is not true; contrary to accepted belief (3). As shown in Figure 7, there were 5 highly anaplastic tumors after 60 years. This is of importance in determining the type of treatment; the decision at present being made primarily on clinical data. This will be discussed below.

In summarizing it was found that because of its use in the young age group, in most of the patients receiving testosterone the tumors were of high malignancy (8). Of these only one responded; the growth remaining temporarily stationary. The tumors in 2 patients showing clinical improvement (O.S. and

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Histologic grading, to be sure, is at best an approximation and sort of average of many field sections. However, it soon becomes evident that each tumor, although not uniform, tends to fit into one class. The two extremes are well separated, though there is, of course, some overlap in the central group. This is brought out in Figures 1 through 6. In very few instances the tumor in the lymph node differed in degree of malignancy from the primary, in which instances the grading of the metastasis as considered representing the lesion under treatment.

was carried out. In 146 of these cases the source of the atypical cells was believed to be a tumor in the bronchial tree. In 141 of the 146 cases a final diagnosis of primary or metastatic carcinoma of the lung was made. In 3 cases diagnoses made on the basis of smears were proved to be false positives. In 2 cases the final diagnosis whether inflammatory or neoplastic was not definitely established.

Carcinoma cells in sputum or bronchial secretions provided the only preoperative microscopic evidence of cancer in 25 (43 per cent) of a total of 58 cases in this series in which surgical exploration was carried out.

Of 24 cases of bronchogenic carcinoma in which the lesion could be removed cancer cells in the smears provided the only microscopic evidence of cancer in 9 cases (37 per cent).

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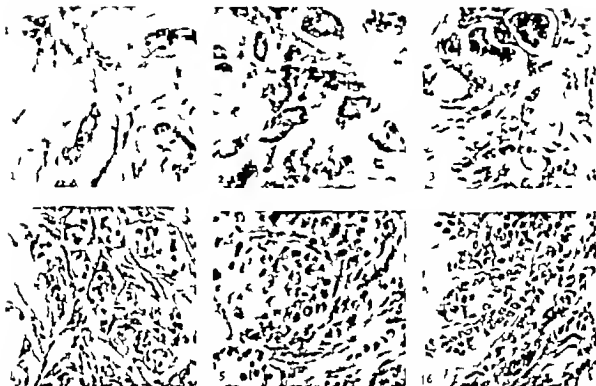
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Figs. 1 to 6. Histologic grading of carcinoma of the female breast. (Hematoxylin and eosin, X300.) The figures are arranged in order of increasing malignancy. Information concerning these examples is shown in the following table. (It is to be noted that details of grading of this particular area might differ from that shown in Tables I and II, though the class and total remain the same.)

Fig.	Case	Glands	Secretion	Uniformity of		Lack of inclusions	Class	Response
				Cell	Nucleus			
1	B	—	—	++	+	—	Low	Improved with testosterone
2	I. W.	1+	—	+++	—	+++	Low	Improved with estrogen (adjuvant therapy)
3	M. R.	+	—	—	—	+++	Medium	With nodes deep with estrogen. No recurrence
4	F. T.	—	—	—	—	++	Medium	Pain not severe, no change in axillary mass
5	M. W.	—	++	+	+	—	High	Lesions progress with estrogen
6	I. W.	—	—	+	+	—	High	Lesions progress with estrogen

B.S.) were of medium and low malignancy. The improvement in these patients refers to osseous metastases (8) and this will be discussed further below.

A similar trend was found in respect to the patients treated with estrogens. Thus the 2 patients with tumors of low malignancy improved, 5 of the 8 of medium and only 1 of the 7 of high grading. The results for the whole series are shown graphically in Figure 8.

#### DISCUSSION

Testosterone the substance of choice in young women (1, 7, 8) and of use in control of osseous metastases (1) acts by way of its effect on calcium metabolism (1) showing under still living tumor cells. It is to be expected and is borne out by this series, that more slowly proliferating tissue would be more effectively buried in new forming bone. Those tumors of high malignancy predicted as non-

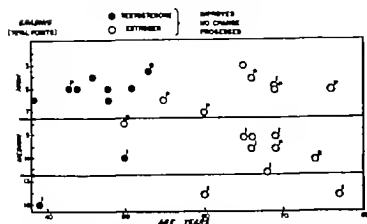


Fig. 7. Malignancy as related to age and to clinical response. Tumors in young women are in general of high malignancy and there is a gradual fall with advancing age. However 3 tumors of high malignancy occurred here in women over 60 years. Also shown is the fact that only 1 tumor of high malignancy improved with hormonal therapy while only 1 of medium or low malignancy progressed.

responsive might well receive concomitant roentgen therapy to local bone lesions (8)

Estrogens of use in older women (7, 8) are effective in control of metastatic soft tissue lesions of low and low medium malignancy (Figs 1 to 6). The decision as to treatment, then, cannot be made on the basis of age alone for highly malignant tumors are present in old women (Fig 7, F.W., aged 76). These soft

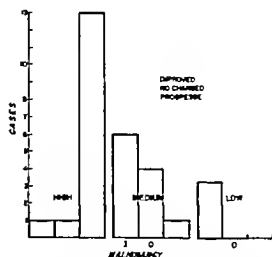


Fig. 8. Response of all hormone treated carcinomatous metastases as related to degree of malignancy

tissue lesions will not be controlled by estrogens and might well receive concomitant x ray therapy from the outset or as symptoms occur (8). It is a matter of conjecture as to the effect of testosterone on bone lesions in elderly people with osteoporotic skeletal systems in which anaplastic cells are proliferating.

Of interest is the history of a long period of cure, with late recurrence of remote lesions of medium malignancy (16 years in the case of M.R., 17 years in the case of M.Ra). It seems likely that the original metastatic cells

TABLE I.—RESULTS AFTER TESTOSTERONE TREATMENT

Case	Age	Known time since original carcinoma	Metastases	Histology of tumor					Grade	Response	Conclusion
				Glands	Secretion	Uniformity of		Lack of mitoses			
						Cell	Nucleus				
B.S.	39	26 months	Skin, lung ribs	++	++++	+++	+++	+++	Low	Subcutaneous—no change. Decrease cough and chest pain	Improved
M.K.	51	1½ years	Bone			+	++	+	High	Relief of pain. No change by -ray	No change
V.S.	38	1½ years	Lung liver		+++	+	+	+	High	Died 4 months	Died
A.C.	51	½ years	Skin, lung		++	+	+	+	High	Symptoms worse	Died
M.T.	41	3 years	Lung, bone			+	++	++	High	Lesions progressed	Died
D.J.	46	years (R) 3 weeks (L)	Liver spine	+		+	+	+	High	Pain less. Died weeks	Died
O.S.	50	7 years	Bone	+++		+++	++	+++	Med.	Complete relief of pain, bone healing by -ray	Improved
A.J.	48	8 years (L) 5 months (R)	Skin	+	++	+	+	+	High	Progressed in skin. Lymph node and liver metastases appear	Died
E.S.	43	4½ months	Lymph node		o	+	++	++	High	Increased size of nodes	Progressed
E.P.	45	5 years	Skin	++		+	+	+	High	New lesions appear	Progressed

++ = plus

TABLE II.—RESULTS AFTER ESTROGEN TREATMENT

Case Age	Known time since original carcinoma	Metastases	Radiology of tumor					Grade	Response	Conclusion
			Glands	Secretions	Underscore of		Lack of nucleus			
					Cell	Nucleus				
B T 77	5 years (R) 3 years (L)	Lung	+++	++	+++	+++	+++	Low	X-ray signs in lung disappear	Improved
B B 7	9 years	Bone	++	+++	++	++	++	Med	Pain less, but no x-ray changes	No change
M R 66	7 years	Axillary	+++	++	++	++	+++	Med.	Decrease size of mass	Improved
J M 30			+	++	++	+	++	Med.	Questionable relief	No change
M R 66	6 years	Three skin nodules	+		+++	+++	+++	Med	Nodules disappear	Improved
E K 60	years	Bone	+++	+	++	++	++	Med.		Progressed
A B 55	months	Bone	+		++	++	+	High	Increased pain	Died
F W 76	1 years	Lung, hilar nodes	+	+	+	+	+	High	Increased x-ray in lung	Progressed
M W 60	years	Axillary nodes, hilar		++	+	+		High	Increased size	Progressed
J H 69	year	Skin, lymph nodes		+	+	+	++	High		Died
I W 60	10 years	Skin, opposite breast, axillary nodes	++++	+	+++	+++	+++	Low		Improved
F T 61	1 years	Lung, bone	+	+++	++	+	++	Med	Lung regressed (bone progressed)	Improved
E F 60	1 years	Axillary lymph nodes	+	+	++	++	+	High	Axillary nodes, no change. Lung increased in size, but retains slow growth	Progressed
J G 66	years	Skin, lymph nodes, lung, liver bone	++	+	+++	++	+	Med.	Skin disappear L. nodes smaller	Improved
E D 69	years	Skin, lymph nodes	+	++	++	++	++	Med	Decreased skin nodules	Improved
I T 65	years	Skin, lymph nodes, lung, bone			+	+	+	High	All lesions increasing	Progressed
C T 69	years	Skin, axillary nodes	++	+	+	+		High	Skin lesions disappear Axillary nodes smaller	Improved

+ = plus

may well have been of slow growth rate, or quiescent, with only recent, more rapid growth and perhaps change of histologic pattern perhaps in a changing environment.

## SUMMARY

Response of remote metastases of carcinoma of the female breast to hormonal therapy is correlated with the histologic grade of malignancy. Tumors of low grade responding most favorably. Degree of malignancy cannot be predicted on the basis of age. It is suggested that information obtained by biopsy examina-

tion be used as an additional factor in determining the clinical management of each patient.

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# THE "VERTICAL EPIDEMIC" OF MAMMARY CARCINOMA IN MICE

## Its Possible Implications for the Problem of Cancer in General

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**O**BSERVATIONS have been made recently on mouse mammary carcinoma which may fundamentally influence our approach to the problem of cancer in general. These observations can be summarized as follows:

There exist families of mice in which in each successive generation, practically all middle aged females develop mammary carcinomas (48, 26 50, 51 52, 9 11 4 5). These animals are for all practical purposes in perfect health during their early adult age although they are earmarked to die from cancer. They develop tumors upon reaching approximately one to one and a half years of age. The causative agent responsible for the development of breast cancer is transmitted in these tumor families of mice from one generation to another through the milk of nursing mothers (10, 14, 17, 1).

### A SIMPLE METHOD OF PREVENTING BREAST CANCER IN MICE

The development of mammary carcinomas in otherwise susceptible mice of the tumor families can be prevented by the simple measure of isolating the newly born animals from their tumor agent carrying mothers and transferring them for the purpose of nursing to females whose milk is free from the invisible mammary carcinoma agent. Such foster-nursed animals grow up and remain healthy despite the fact that they are direct descendants of a tumor family. They live their normal life spans and do not develop breast tumors. Moreover, their milk is also free from the tumor agent, they can, in due time, nurse their own litters naturally, without transmit-

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ting to them the seed of the fatal disease (10, 14 17, 1).

On the other hand, female mice that belong to families free from mammary carcinoma, can be infected with the invisible tumor agent by ingesting, in early infancy milk containing the mammary carcinoma factor. The infection can be accomplished experimentally by placing such newly born mice under the care of a foster mother whose milk contains the tumor factor. Such infected animals grow up and remain apparently healthy, they harbor however, the tumor agent and transmit it to their progeny. When these animals reach the tumor age they develop and eventually die from mammary carcinomas. In the meantime however, their progeny has grown up, and has, in turn transmitted the tumor agent to the next succeeding generation.

### BIOLOGICAL PROPERTIES OF THE TUMOR AGENT

The mammary carcinoma agent present in the milk of females of certain high tumor lines of mice earmarked to develop breast tumors later in life is so small as to be invisible under an ordinary, optical microscope. The agent is filterable through a bacteria tight Seitz filter (19 7).

The agent is present not only in the milk of female mice earmarked to develop mammary carcinomas, but also in the tumor cells (15). When such tumors are transplanted by graft, from one animal to another they carry with them the tumor agent which can later be extracted from such tumors after several successive transplantations (21). The agent is present in the mammary tissue (13, 6) of mice earmarked to develop mammary carcinomas less constantly in certain organs of such animals (12, 6) and occasionally also in their blood (59). The simplest method of obtaining the agent is to grind a mammary tumor, whether



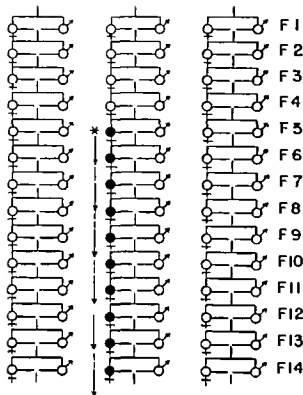


Fig The spread of mammary carcinoma following exposure, that is, the ingestion of milk containing the tumor agent.

spontaneous or transplanted, with physiological sodium chloride solution and then separate the agent from the tumor cells by centrifugation at low speed. The agent is present in the supernatant fluid. A few drops of such a fluid fed to newly born mice by an eye dropper or a simple feeding device (40) will result in the development of spontaneous mammary carcinomas in these animals a year and a half later. In the meantime however these animals will have already transmitted the agent, through milk, i.e. naturally to their own progeny.

Oral administration of the agent is effective, and results in the eventual development of tumors, provided the animals ingest the virus in early infancy i.e. when 1 to 28 days of age. Feeding of adult or middle aged animals with either milk or extracts from tissues containing the tumor agent, results occasionally only if at all, in the development of mammary carcinomas (6 20). Subcutaneous or intraperi-

toneal (7) injection of the agent into young animals is an excellent means of producing experimentally spontaneous mammary carcinomas when older animals, however are injected, they will develop tumor much less frequently or not at all (3 6 20 23) unless massive doses of the virus are inoculated (23).

The tumor agent is destroyed by heating to 63 degrees C. for 30 minutes. Thus, the agent would not resist pasteurization (7 8).

The tumor agent has antigenic properties (7 31). Following injection of the agent (i.e. a mouse mammary carcinoma extract) into a rabbit, no tumors, of course develop in these animals. The serum of such a rabbit, however acquires the property of neutralizing the agent in vitro. When such an immune serum is incubated, in a test tube, at room temperature, for 2 hours with mouse mammary carcinoma agent, it neutralizes it. The mixture injected into mice will not produce tumors. The neutralization is specific. Normal rabbit serum, for instance, will not neutralize the tumor agent (7 31) neither will the mammary carcinoma agent be neutralized by a serum obtained from a rabbit that had been injected with a different tumor (7) or with normal mouse organs (31).

The various biological properties of the mouse mammary carcinoma agent discussed above appear to suggest that this agent is a virus.

#### MAMMARY CARCINOMA OF MICE— A COMMUNICABLE DISEASE

Thus, in mice at least, mammary carcinoma can be acquired in early infancy by ingestion of an extraneous transmissible agent. Once acquired the disease is self propagating from one host to another through the milk of nursing females. The chain of transmission of mammary carcinoma in a family of mice can be interrupted, however by isolating the newly born animals from their potentially cancerous mothers and preventing them from ingesting the tumor agent. In other words, mouse mammary carcinoma can be acquired by exposure (Fig 1). Once acquired, it becomes self perpetuating from one host to another. The acquisition of the disease can be prevented however by isolation (Fig 2).

Upon reviewing these facts dispassionately, it is difficult to avoid the conclusion that breast cancer of mice is a communicable disease (33)

#### THE VERTICAL PATTERN OF TRANSMISSION OF MOUSE MAMMARY CARCINOMA AGENT

When comparing the pattern of transmission of mammary carcinoma of mice with that of many common communicable diseases, several differences become apparent. In the case of measles, smallpox or typhoid fever, the transmission of the infectious agent occurs among hosts that, in most instances at least, belong to the same generation thus an infected host placed in close quarters with other, healthy, but susceptible individuals of practically any age will often transmit the infecting agent to its companions. In the case of mouse mammary carcinoma, however, the causative agent is as a rule transmitted among hosts belonging to successive generations. A mouse carrying the tumor agent and bearing a large exposed perhaps already ulcerated mammary carcinoma can be placed in the same cage with healthy susceptible mice yet, no transmission of the disease will result. The same tumor bearing mouse, however, will transmit the tumor agent, through milk, to her own daughters, and through these to her granddaughters, great granddaughters, and so forth i.e. to hosts of successive generations. The term vertical epidemic has been suggested for this type of transmission of extraneous parasitic agents (33)

In mouse mammary carcinoma the exposure and infection occur early in infancy. This is followed by apparent health lasting at least through the early adult life of the host during that time the disease spreads to the next group of hosts which belongs to the next succeeding generation. The symptoms of the disease (tumors) appear in most instances at the end of the life cycle of the host, i.e. after the transmission of the causative agent has been assured this is followed by death of the host. Thus we have (1) exposure and infection followed by (2) a very long asymptomatic phase of apparent health coupled with (3) the ability of the host to transmit the disease

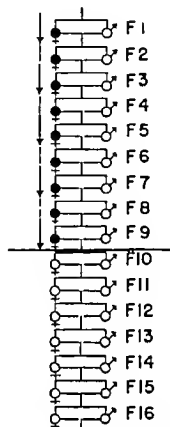


Fig. 2. Arresting the vertical transmission of mammary carcinoma in mice by isolation, that is foster nursing, preventing the ingestion of milk containing the tumor agent.

to other individuals and finally (4) appearance of symptoms of disease, and (5) death of the host.

This pattern is essentially different from that observed in the majority of common communicable diseases where, following (1) exposure and infection (which may occur at almost any time during the life cycle of the host) very promptly (2) symptoms of the disease appear coupled with (3) the simultaneous ability of the host to transmit the infectious agent to other susceptible individuals belonging as a rule to the same generation (4) either death or recovery of the host follows.

#### THE SKIPPING OF GENERATIONS IN THE TRANSMISSION OF MOUSE MAMMARY CARCINOMA

Despite these differences there are certain common traits between these two patterns. Both groups of diseases are caused by extraneous parasitic agents. In both instances an individual may harbor the agent and actually



follow the actually continuous, though at times inapparent, chain of transmission of the causative tumor agent. If complete records are on hand, the pattern of transmission he comes at once evident it then becomes clear that each case of mammary carcinoma can in these animals be traced to another similar case of the same disease. The law of obligate communicability (Fig 4) long established for other infectious diseases, becomes then evident also for mammary carcinoma of mice (33)

#### THE TRANSMISSIBLE INACTIVE FORM OF THE TUMOR AGENT AND ITS DELAYED ACTIVATION IN THE HOST

Among the many questions which immediately present themselves, one of the most striking is that concerning the very long interval of time which passes between the exposure of the host to the transmissible agent (early in fancy) and the actual appearance of symptoms of the disease i.e. the formation of the tumor

It appears possible to assume that the invisible tumor agent is transmitted from one animal to another in some inactive form and that it remains inactive and harmless during most of the life span of its host. Usually at the end of the host's life cycle conditions may develop which at least in some instances, may prompt an activation of the hitherto inactive tumor agent. The conditions favoring such activation have not yet been fully determined, and are poorly understood at least some of these conditions however are known, as for example old age or certain hormonal stimulations.

Upon activation of the tumor agent, a new growth develops at the site of the activation i.e. locally in the cells where the agent was harbored and where activation actually occurred. From then on the activated agent causes the cells to multiply at the point of activation. The tumor then grows rapidly in filtrating the surrounding tissues not unlike any local infection. It may also spread through the lymphatic channels into either adjoining groups of lymph glands or apparently through migrating tumor cells it may form distant metastases.

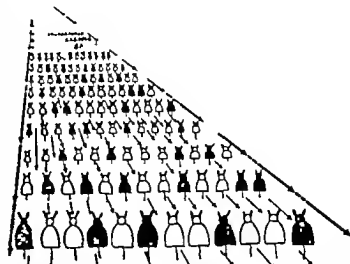


Fig 4. The vertical epidemic of cancer (1) This is not inheritance, but a vertical transmission of an extraneous parasitic agent. (2) The agent is communicable from one individual to another of successive generations. (3) Many carriers transmit the virus but never show any symptoms of disease.

#### THE ACTIVATION OF TUMOR AGENT IS LOCAL

It is possible to assume that only a small fraction of the agent, which is harbored by the host, becomes at one time activated, forming a new growth and that the activation is thus a purely local phenomenon. The remaining inactive agent, harbored elsewhere by the same host, may not become activated at the same time. Thus a host that bears a tumor (caused by an activated agent) may harbor in addition, in other, apparently healthy tissues the remaining inactive tumor agent. At a later date however, should the host survive for a prolonged period of time additional new activations of the tumor agent may occur at new sites forming new primary tumors. This would explain the commonly observed fact that spontaneous mammary carcinomas may develop successively in several different mammary glands in a mouse. Conditions favoring the initial activation may either persist or again develop causing successive appearance of several similar tumors. The activation theory would perhaps explain why tumors that appear to develop only in middle aged or old animals once they develop will grow indiscriminately upon transplantation, in either old or young hosts. Thus it is not a resistance of the young animal to the tumor, but the lack of an active tumor agent that is responsi-

ble for the absence of spontaneous mammary carcinomas in youth and early adult age. Once activated however the tumor seems to be equally capable of growing when transplanted in susceptible hosts of any age (32)

#### THE VERTICALLY TRANSMITTED PARASITIC AGENTS IN INSECTS AND PLANTS

There exist many communicable diseases which are transmitted vertically and which in principle at least, follow the pattern observed in mammary carcinoma of mice. The Rocky Mountain spotted fever rickettsiae (49) or the tularemia organisms (41) (Fig 5) for instance are transmitted in the tick through the eggs of these insects from one generation to another i.e. vertically. The horizontal transmission of these organisms that is a transmission between insect hosts belonging to the same generation is possible when an intermediary host such as man for instance intervenes. In the absence of a suitable intermediary host, however only vertical transmission occurs. Many other communicable diseases of insects exist that are known to be transmitted from one generation to another vertically (49 41 42 27 39) not unlike mammary carcinoma of mice.

Similar observations have been made on plants. Thus, it was observed that certain diseases of plants, caused by extraneous filterable viruses, are transmitted from one plant to another through the seeds. An infected plant may grow next to a healthy one and yet no transmission of the disease will occur among hosts belonging to the same generation. However the infected plant will transmit the virus through the seeds or in the case of mosaic disease of the potato through the tubers, to the next generation. The transmission through the seeds or through the tubers, from one generation to another is essentially a "vertical transmission of the parasitic agent, fundamentally similar to that observed in mammary carcinoma of mice (Fig 6) The same is true for the mosaic disease of lettuce, tomatoes or certain other plants (30 38)

The vertically transmitted parasitic agents can readily escape detection, particularly when such parasites are invisible, and when they do not always cause symptoms of disease.

The detection becomes somewhat easier in experiments conducted on hosts having a relatively short life span and a rapid reproduction cycle under such experimental conditions the actual host-to-host transmission of the pathogenic agents can be more readily followed by the human observer. Even in such instances, however the difficulties are great, and great patience is required.

#### VERTICAL EPIDEMIC IS NOT TO BE CONFUSED WITH HEREDITY

At first sight vertical transmission may be perhaps confused with inheritance. Upon observing a disease appearing successively in different descendants of the same family a casual observer may be tempted to consider it to be caused by some inherited genetic factor. And yet inheritance and vertical transmission are fundamentally different phenomena. A vertically transmitted mammary carcinoma is actually caused by a host-to-host transmission of an extraneous, acquired, parasitic agent. The same is true for mosaic disease of plants or certain vertically transmitted virus diseases of insects.

Inheritance on the other hand, is neither acquired nor is it caused by extraneous, parasitic agents.

#### IMPORTANCE OF SUSCEPTIBILITY IN THE DEVELOPMENT OF MOUSE MAMMARY CARCINOMA AS COMPARED WITH OTHER COMMUNICABLE DISEASES

The proper susceptibility of the host to the disease-causing agent is obviously fundamental in the development of mammary carcinoma of mice. This factor however is equally important in other communicable diseases, since pathogenic micro-organisms or viruses can act only on susceptible hosts. Plague for instance, is highly dangerous for man and certain rodents, but harmless for chickens. The susceptibility of man to plague is inherited and yet, no one would state that plague, in man is caused by (a) the plague bacillus and (b) inherited susceptibility of man the plague bacillus only would be mentioned as the causative agent, since it goes without saying that this micro-organism will produce disease only in a susceptible host.

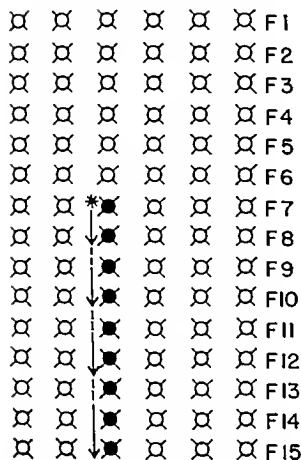


Fig. 5 Vertical transmission of tularemia in tick following exposure that is, feeding on a host infected with tularemia.

It is true that some mice are more others less susceptible to the tumor agent and that such a susceptibility is inherited. This fact however would not surprise an epidemiologist. Thus field mice are relatively resistant to streptococci or pneumococci whereas albino mice are very susceptible to these organisms (28) by inbreeding of either susceptible or nonsusceptible parents two different lines of mice were obtained by Webster one showing 95 per cent mortality and the other only 5 per cent under the same conditions of exposure to the *Bacillus enteritidis* (57).

The importance of inherited susceptibility in the acquisition and development of mammary carcinoma should be viewed in its proper perspective and should be neither overemphasized nor misinterpreted. The susceptibility of the host which is essentially inherited seems at least in principle no more important in the origin of mammary carcinoma than it is in the acquisition of diseases caused by various micro-organisms and viruses (33).

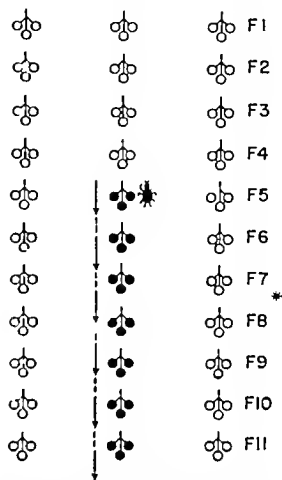


Fig. 6 Vertical transmission of mosaic virus in the potato following exposure. A plant louse (potato aphid) infected with mosaic virus fed on leaf of potato.

#### NO PEDIGREED INBREEDING NEEDED FOR TRANSMISSION OF MOUSE MAMMARY CARCINOMA

When the initial observations on vertical transmission of mammary carcinoma were made on mice it appeared at first that genetic inbreeding is of paramount importance in such host to-host passage of the tumor agent. It was later observed however that no pedigree inbreeding is required for such a transmission and that the promiscuous breeding such as exists in nature gives also the tumor agent an opportunity to pass from one host to another of successive generations.

Thus middle aged mice that develop mammary carcinoma spontaneously can be found occasionally among the animals sold to clinical laboratories by dealers and known as market mice. Such animals are of course of unknown genetic origin being the offspring of promiscuous breeding. When such

tumor bearing females were mated successively to several genetically unrelated males numerous spontaneous mammary carcinomas developed among their offspring (24-25) apparently these mice transmitted the tumor agent to their progeny even though they were far from following any rules of pedigreed inbreeding.

In another experiment mice that were born to market albino mice of unknown ancestry were foster nursed by female mice of the C<sub>3</sub>H line whose milk was known to contain the tumor agent as a result 14 of 17 foster nursed females i.e. 82 per cent developed mammary carcinomas upon reaching approximately 1 year of age (7). Eighteen sisters of these females were nursed as controls by their own albino mothers and none of these died of cancer. These experiments were repeated and confirmed in this laboratory (32). In our series 23 albino females of unknown ancestry obtained from a clinical laboratory were transferred within 24 hours after birth for the purpose of foster nursing to female mice of the C<sub>3</sub>H line (Fig. 7). Sixteen of these i.e. 70 per cent developed carcinomas at the average age of 15 months (Fig. 8). No tumors were observed among the not fostered females. Thus, here again the ingestion of the tumor agent in infancy resulted in the development of tumors in mice of unknown ancestry.

#### HORMONAL STIMULATION AND BREAST CANCER

When the initial observations were made suggesting that mammary carcinoma could be produced in male mice by either implanting ovaries or injecting follicular hormones it was thought at first that this was a cancer of hormonal origin (39). Only subsequent experiments have demonstrated that no amount of follicular hormone would produce mammary carcinomas in mice that do not carry the specific tumor agent (18, 40, 47, 54). Thus in families of mice that apparently carry the tumor agent i.e. in which the majority of females develop spontaneous mammary carcinomas the male population remains free from these tumors even though the males also carry the tumor agent. Such males will develop mammary carcinomas however if their mammary glands are stimulated by early and po-

tent injections of follicular hormone. On the other hand similar application of the follicular hormone to male mice belonging to families free from the mammary carcinoma agent, i.e. to families whose females do not develop breast cancer will not result in the development of tumors. If males of such tumor free families, however are foster nursed by females carrying the tumor agent and then injected with follicular hormones mammary tumors will develop.

It is now clear that mammary carcinoma is not caused by hormonal stimulation, but by the transmissible tumor agent. Obviously the agent must act on susceptible hosts to produce symptoms of the disease in addition to the general inherited susceptibility of the host, the agent apparently also requires active, and adequately stimulated mammary gland tissue in order to actually form a tumor. Repeated pregnancies, or injection of potent follicular hormones may in such cases prompt the development of tumors (4, 11) provided of course that the specific tumor agent is harbored by the host.

The mammary carcinoma agent seems to have a discriminatory affinity for particular groups of cells (mammary glands) within the host. It is well to remember however that in this respect again the mammary carcinoma agent does not, in principle, differ from many other pathogenic viruses. To give an example the infantile paralysis virus has a distinct affinity to certain cells of the spinal cord of man. Many other micro-organisms possess a limited affinity to certain groups of cells within a limited range of susceptible hosts.

Hormonal stimuli may also distinctly influence the susceptibility of the host to various communicable diseases; thus, males have long been observed to be more susceptible than females to many infectious diseases in both human and animal pathology (28). On the other hand the hormonal stimuli may in certain instances increase the resistance of the host to parasitic agents. *Tinea tonsurans*, for example occurs in childhood but does not usually affect sexually mature individuals (45).

Thus, hormonal stimulation like inherited susceptibility may at first sight perhaps, ap-



Fig. 7. A newly born litter of albino 'market' mice of unknown ancestry, was foster nursed by a female of the C3H line whose milk contained the tumor agent



Fig. 8. One of the majority, 70 per cent, of the foster nursed albino females that developed spontaneous mammary carcinomas upon reaching 1½ years of age

pear to be of unusual importance in the origin of mammary carcinoma of mice and that of cancer in general. Upon reviewing these observations on a broader basis however it becomes apparent that inherited susceptibility and hormonal stimulation are both also essential in the development of various communicable diseases.

#### THE IMPLICATIONS OF THE NEW APPROACH TO THE PROBLEM OF CANCER

The theoretical implications of the observations discussed are considerable. To begin with it appears difficult to consider that the mouse mammary carcinoma develops spontaneously. Breast cancer in mice appears to be no more spontaneous than a case of tuberculosis or typhoid fever. Provided that sufficient records are on hand each case of tuberculosis or typhoid fever could obviously be traced to another case of similar disease, the conditions being caused by specific transmissible agents. The same appears to be true for mammary carcinoma of mice. It is well to remember that only a generation or two ago many physicians thought that tuberculosis, typhoid fever, or for that matter a number of other communicable diseases were of spontaneous origin and resulted from various different internal and external causes. As late as 1885 typhoid fever and diphtheria were believed to originate *de novo* in filthy surroundings (44). The discussion on spontaneous tuberculous degeneration (43) printed

in the *Bulletin* of the French Academy of Medicine in 1867 may appear amusing to a contemporary physician in 1866 however the suggestion advanced by Villemin (55) that tuberculosis is not a spontaneous disease but is caused by a transmissible parasitic agent did not gain much support among his contemporary colleagues. It took years to demonstrate the law of obligate communicability for all infectious diseases.

We do not know at the present time of any communicable disease that would develop *de novo*. There is no convincing evidence to support the idea of spontaneous generation of any no matter how small parasitic agents. Invisible viruses are much more difficult to detect than the larger microbes. If they are harbored by a host without causing symptoms of disease they may remain undetected without attracting attention of the most careful observer. They may then pass to other hosts and at a later date cause symptoms of disease so unexpectedly as to give the impression of being produced *de novo* or by some obscure process of mutation.

One of the most interesting features of the epidemiology of mouse mammary carcinoma is its vertical transmission, i.e. the passage of the virus from one generation to another. In the case of many common communicable diseases the chain of infection spreads among individuals of the same generation, i.e. horizontally, as a result many consecutive cases of transmission of the disease from one in



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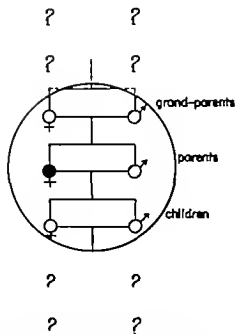


Fig. 9 Cancer appears to be a spontaneous disease. In most instances information available is limited to three generations, that is: the individual concerned, and the next succeeding and preceding generations.

dividual to another occur within a comparatively short time and the whole picture of a communicable disease is clearly discernible to any individual observer. In the case of tumors however the epidemiological picture is fundamentally different. Thus in the case of mammary carcinoma at least the pathogenic agent is transmitted from one individual to another of successive generations many of the individual carriers may actually harbor and transmit the virus but never show any symptoms of disease.

Theoretically it is possible to assume that breast cancer could kill the great grand mother then skip the grandmother mother and so forth only to reappear perhaps in the great granddaughter in its usual form of a typical breast carcinoma. In reality the tumor agent does not skip any of the individuals through which it passes. They all carry the tumor agent though many of them never show any symptoms of tumors. Because however the mammary carcinoma agent can cause no symptoms, and because it is transmitted vertically it may actually submerge for one two or more generations of hosts

disappearing entirely from the sight of the most patient observer (Figs. 9 and 10) Years, and in man perhaps even a century or two may sometimes elapse between cases of disease that have been caused by transmission of the same pathogenic agents (34, 35)

#### SPONTANEOUS GENERATION" AND MOUSE MAMMARY CARCINOMA

The law of obligate communicability is at the present time so generally accepted that no one would venture to state that he observed a case of spontaneous tuberculosis even though here and there cases of unquestionable clinical tuberculosis might have been observed with apparent difficulty in demonstrating the presence of the specific pathogenic agent. In the case of mammary carcinoma of mice, however it appears to some authors at least perfectly plausible to state that a case of mouse mammary carcinoma has been observed which has not been caused by a transmissible milk factor (i.e. tumor virus) because no presence of such a tumor agent could be demonstrated in the particular case by the investigators (37). Thus, some investigators still believe that certain mouse mammary cancers are caused by a specific, transmissible agent while others, clinically identical tumors developed *de novo* (16) and are of spontaneous origin. Actually, however the concept of "spontaneity" of mouse mammary carcinoma seems untenable in view of the experimental evidence suggesting that breast cancer of mice is communicable from generation to generation and that its appearance can be effectively prevented by isolating the potentially cancerous mothers from their newly born progeny.

#### HUMAN TUMORS

The 'vertical transmission of mammary carcinoma in mice from one host to another through a filterable agent contained in the milk of nursing mothers has been established experimentally beyond any reasonable doubt. The question arises immediately whether this origin of breast cancer is limited to mice or is valid also for other species of mammals including man. In addition the question also arises whether tumors other than mammary

carcinoma have a fundamentally different etiology

No exact answer is possible at the present time to either of these important questions. Until more information on experimental cancer is obtained, only a tentative assumption based on theoretical considerations could be ventured. It is possible to assume however that mammary carcinoma of mice does not represent a form of cancer different from breast cancer in other mammals. If this assumption is correct, the law of obligate communicability may in the future be established also for breast cancer in such animals as rats, rabbits, or dogs and perhaps also in women.

#### PREVENTING HUMAN BREAST CANCER BY ARTIFICIAL FEEDING?

Should such a possibility materialize the eradication of human breast cancer may become feasible by the simple method of artificial feeding of infants born to mothers having a family history of tumors (17, 33, 34, 35).

There is at the present time no other way of suspecting the presence of the tumor agent in the milk of a nursing female mouse except by checking her family record for the occurrence of tumors. A female mouse whose milk contains the tumor agent is in perfect health at the time of nursing; she will develop mammary carcinoma upon reaching middle age if she develops a tumor at all; she may die before she reaches the tumor age; on the other hand she may live her normal life span and yet never develop a tumor (although she carries and transmits the tumor agent) if her diet is restricted (36, 53, 58) so as to cut her caloric intake by 30 to 50 per cent. The only way to determine whether she carries and transmits the tumor agent is to check her family record. Her mother might have died without a tumor as well as her grandmother, but perhaps a sister of her mother or her great grandmother for instance developed a mammary carcinoma.

The same may be true for human breast cancer. Thus a history of breast cancer in the family of a nursing and apparently healthy mother may indicate the presence of a tumor agent in her milk. Since no more than a few hours of breast feeding may suffice to transfer

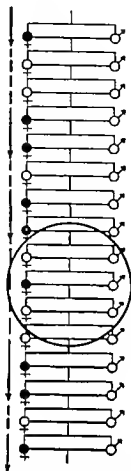


Fig. 10. The vertical transmission of cancer becomes discernible only when records are available covering a sufficient number of generations.

the tumor factor, the conclusion seems justifiable that breast feeding in such instances should be abandoned *from birth*. It might suffice to omit breast nursing for one single generation in order to interrupt the flow of the virus. Breast feeding could then be resumed in the succeeding generations.

Since the tumor agent does not appear to resist heating to 61 degrees C. for 30 minutes (7, 8) feeding of pasteurized human milk (56) should also be considered.

#### THE ORIGIN OF TUMORS OTHER THAN MAMMARY CARCINOMA

The second important question requiring clarification is that dealing with the possible origin of tumors other than mammary carcinomas. Except for some particular tumors of dogs, chickens, frogs, or rabbits there is in the great majority of instances no evidence to suggest that the various sarcomas and carcinomas that develop for obscure reasons in

different organs of animals and man, are caused by transmissible agents. And yet, it is difficult not to be impressed by the fact, that in various species of hosts, such as mice, rats, rabbits, chickens, fish, cattle etc. families have been observed with an incidence of either tumors, or allied diseases, such as leucemias, substantially higher than that of the average population. Also in man it is rather difficult to ignore the often striking frequency of malignant tumors developing in members of families of patients suffering from cancer (33). This observation has been made so often that a positive for cancer family record is actually considered to be of diagnostic value (22).

In principle it appears possible, perhaps even reasonable, to assume, that mammary carcinoma of mice does not represent a form of cancer fundamentally different from at least some of the other malignant neoplasms. If this assumption is correct, the law of obligate communicability may in the future become established also for tumors other than breast cancer (33). Such an assumption would not necessarily imply that milk only should be considered as means of natural transmission of a causative tumor agent. Tumors are not limited to mammals, and it would only be logical to assume that means of transmission other than milk also exist should such transmission occur at all.

#### A WORKING HYPOTHESIS

The observations discussed above are as yet insufficient to draw any generalized conclusions. It is possible nevertheless, to advance a working hypothesis as to the origin of at least certain malignant neoplasms in animals and also in man.

There may exist a group of transmissible agents causing tumors in animals and in man these agents would be so small as to be invisible under an ordinary optical microscope they would possess many of the characteristics of pathogenic viruses. These agents would be fundamentally similar in certain features of their behavior. Thus, they would attack certain groups of cells within certain hosts live and multiply in such cells as a rule these tumor agents would be frugal and moderate in their requirements, and would not apparently

injure the host. For obscure reasons, however the pathogenicity of the agent may sometimes change during the latter part of the life of the host, and a tumor would then develop usually sealing the fate of the host, i.e. growing progressively and if not treated killing the host. The survival of the agent would have been in the meantime secured however by transmission to another host occurring as a rule prior to the appearance of symptoms of a tumor in the transmitting individual.

One of the most striking features of the pattern of natural transmission of these agents would be their faculty to pass 'vertically' from one host to another of successive generations. The generation-to-generation transmission with occasional 'skipping' of intermediate carriers, i.e. with skipping of generations, would make the task of tracing the epidemiological course of the tumor agent extremely difficult, and time consuming. Although the tumors would in principle belong to the general group of communicable disease, transmission would occur as a rule among hosts of successive generations.

The agent would appear to be able to attack new hosts efficiently in either their embryonic stage or in their infancy. A long asymptomatic phase of the disease would then follow during which the host would transmit the agent to the succeeding generation. The activation of the hitherto latent agent in the transmitting host would then follow though it would not always have to occur. The activation of the tumor agent could be prompted by a number of either general or local, non-specific, factors such as those related to aging, by hormonal stimuli or metabolic disturbances, by exposure to irradiation, or to certain systemic poisons, etc. In some instances, the activation of the agent could be prevented by either hormonal influences, by a restricted food intake, or perhaps by some other as yet obscure factors.

Although fundamentally similar in certain features of their behavior these tumor agents would be individually distinct, causing different malignant neoplasms, not unlike the array of rickettsial micro-organisms responsible for the various forms of typhus. If this assumption is correct, the number of animals,

and people, with demonstrable tumors would represent only a fraction of those actually carrying the disease (33)

#### SUMMARY AND CONCLUSIONS

1 Mammary carcinoma of mice, a disease essentially similar to breast cancer of women, is caused by a filterable agent, which is transmitted from one generation to another through the milk of nursing females. This agent can be destroyed by heating to 61 degrees C for 30 minutes i.e. it would not resist pasteurization. The agent has antigenic properties, and can be neutralized *in vitro* by a specific immune serum.

2 The development of mammary carcinoma in mice can be prevented by the simple method of isolating the newly born animals from their potentially cancerous mothers, and by transferring them for the purpose of nursing to female mice whose milk is free from the tumor agent.

3 Mice of either pedigreed inbred lines or offspring of promiscuous breeding can be infected in infancy by ingesting the mammary carcinoma agent. They remain then in perfect health, through their early adult life. Upon reaching one to one and a half years of age, however they develop mammary carcinomas. In the meantime they have transferred the tumor agent to their own offspring and have thus assured the continuation of the disease in the next group of hosts.

4. Thus a female mouse which is nursing is in perfect health at the time she is actually infecting her offspring with the tumor agent. The only indication suggesting that she harbors and discharges the tumor virus is her record showing that mammary carcinomas developed in her female ancestors.

5 These observations suggest that mammary carcinoma is not a spontaneous disease. The law of obligate communicability long established for other infectious diseases appears to be valid also for breast cancer of mice.

6 The natural transmission of mammary carcinoma agent occurs only from one host to another of successive generations. The term "vertical epidemic" has been suggested for this type of transmission of pathogenic agents

Many parasites of plants and insects follow this pattern of transmission, passing from one host to another through either seeds or ova. "Vertical epidemic, however, should not be confused with inheritance, these are two fundamentally different phenomena.

7 The possibility is discussed that mammary cancer of other mammals, including man may also be caused by agents similar to that responsible for mouse mammary carcinoma. If this assumption is correct, women who have a family history of tumors should not nurse their babies artificial feeding, or feeding with pasteurized human milk should be substituted. This simple preventive measure may interrupt the flow of the virus and eradicate human breast cancer within one generation breast nursing could then be resumed.

8 It is possible to assume that mammary carcinoma of mice is not exceptional in its etiology, but represents a condition essentially similar to other neoplasms. If this is true other malignant tumors may eventually prove to be caused by transmissible agents. It would then be logical to assume however, that milk is not the only means of transmission of such agents transfer through ova, and otherwise, would also have to be considered.

9 The hypothesis is advanced that there exists a group of viruses causing various malignant tumors in animals and in man. These viruses would live in close association with normal cells be usually frugal and moderate in their requirements, and cause no symptoms of disease. They would be transmitted among hosts of successive generations i.e. vertically. In most instances the carriers would never show any symptoms of tumors. Occasionally, however prompted by obscure factors, the tumor virus would become activated, causing a local new growth.

10 Because of the existence of many asymptomatic carriers however and the occasional "skipping" of generations it would only become possible actually to trace the host to-host passage of the "vertically" transmitted tumor agents when accurate and complete mortality records are on hand covering the span of many successive generations.

11 If this hypothesis is correct it would logically follow that should such records ever

become available, each case of human cancer could then be traced to another case of a malignant tumor in one of the patient's ancestors.

12. The comparatively high incidence of tumors in families of patients suffering from cancer long recognized by various observers, would thus assume a more than incidental significance. Accordingly a family history of cancer should perhaps be more appreciated from the point of view of its possible diagnostic value particularly in patients with symptoms difficult to be properly classified.

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## SUBMUCOUS LIPOMA OF THE COLON

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MANY reviews and individual reports of cases of submucous lipoma of the colon have appeared in the literature since Bauer in 1757, reported the spontaneous elimination of a lipoma, probably from the colon. A recent contribution to the subject is that of Pack and Booker, who stated that 153 cases of submucous lipoma of the colon had been reported in the literature to the time of completion of their paper.

The purpose of this study is to add to this number 19 cases of submucous lipoma of the large intestine in which operation has been performed at the Mayo Clinic from January 1 1936 through December, 1947 and also to review briefly the salient features of symptomatology situation and surgical procedures performed for the condition.

Comfort and Pemberton and McCormack reported 24 cases of submucous lipoma of the large intestine from the clinic. These together with the 19 cases reported in this paper make a total of 43 cases in which operation has been performed for this particular condition at the Mayo Clinic up to and through the year 1947.

Lipomas of the colon occasionally are found on routine necropsies these growths are relatively small and asymptomatic and since they are incidental findings they are only of academic importance.

### REPORT OF CASES

**CASE 1.** An unmarried woman aged 50 years came to the Mayo Clinic on October 31 1935 because of attacks of pain in the right side. The attacks had occurred intermittently for 12 years the last one a week before admission. Examination disclosed a fibroid tumor and retroversion of the uterus. Total hysterectomy bilateral salpingo-oophorectomy and appendectomy were performed on November 2 1935. Convalescence was uneventful and the patient was dismissed on November 25 1935.

On February 10, 1936 she returned because of pain in the epigastric region which she had experienced first shortly after the previous operation and

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which had increased steadily in severity. She also had had several attacks of mild intestinal obstruction. Physical examination revealed extreme tenderness and definite muscular rigidity in the right portion of the epigastrium. Roentgenologic examination of the colon revealed cecocolic intussusception the cause of which could not be determined at the time.

On March 14 an exploratory laparotomy disclosed a lipoma of the cecum which had caused intussusception and partial obstruction of the intestine. Because the peritoneum in the ileocecal region was thickened and it was thought that the lesion might be malignant, about 3 inches (7.6 cm.) of the ileum, the cecum the ascending colon and several inches of the transverse colon were excised and the continuity of the intestine was re-established by side-to-side anastomosis. An ileostoma was established but this was closed at a later date. The pathologist reported that the tumor was a submucous lipoma which measured 6 by 5 by 4 centimeters. The surface of the tumor was ulcerated. When the patient was last heard from she was in good health.

**CASE 2.** A married woman aged 58 years came to the clinic on October 18 1937. In February 1937 she first had noticed a mild burning pain in the right upper quadrant of the abdomen which had not been related to the ingestion of food. In August, 1937 roentgenologic examination had disclosed a filling defect in the first part of the transverse colon and in October 1937 roentgenologic examination had disclosed a polypoid tumor in the first part of the transverse colon. She had not had any diarrhea, constipation or change in bowel habit. Her stools had not contained any mucus or blood.

Physical examination revealed some tenderness in the right side of the abdomen. Proctoscopic examination did not reveal any abnormality. Roentgenologic examination of the colon revealed some changes in the cecum and ascending colon which were suggestive of amebic colitis. Therefore treatment for amebiasis was instituted. Roentgenologic examination a week later revealed a local inflammatory lesion in the cecum. Hospitalization and treatment were advised. A subsequent roentgenogram revealed a polypoid lesion which was thought to be a lipoma situated in the transverse colon near the hepatic flexure.

At laparotomy on November 12 1937 the last 6 inches (15.2 cm.) of the ileum the ascending colon and the transverse colon were found to be slightly thickened. This thickening was thought to be due to amebic colitis. A tumor was found in the hepatic flexure of the colon and it was removed through a transverse incision in the colon. The pathologist reported that the tumor was a submucous lipoma. It



measured 2 by 3 by 0.5 centimeters. The patient had an uneventful recovery. In a letter received from her 4 years later she did not complain of any difficulty.

**CASE 3.** A married woman, aged 43 years, came to the clinic on April 3, 1939, because of gall bladder colic. Her appendix and a cyst of the right ovary had been removed in 1916. A roentgenologic diagnosis of gallstones had been made in 1938. Hemorrhoids, with occasional bleeding and pruritus, had been present for many years. Proctoscopic examination had not been made.

Physical examination revealed an elongated mass, apparently of the colon, in the right lower quadrant of the abdomen. Roentgenologic examination disclosed that the gall bladder was not functioning in a normal manner. Roentgenologic examination of the large intestine was not made.

On April 6, 1939, exploratory laparotomy revealed a pedunculated tumor which projected into the lumen of the ascending colon. Because there was considerable inflammation of the surrounding tissues and since it was felt that the lesion might be malignant, about 4 inches (10 cm.) of the terminal portion of the ileum, the cecum, the ascending colon, and about half of the transverse colon were excised. The continuity of the intestine was re-established by side-to-side anastomosis. An enterotomy tube was inserted in the ileum at a point about 5 inches (12.7 cm.) above the line of anastomosis. The gall bladder also was removed. The pathologist reported that the tumor was a pedunculated lipoma of the cecum about 5 centimeters in diameter. The overlying mucosa was covered by an ulcer which was about 4 centimeters in diameter. The muscular coat of the surrounding intestine had undergone hypertrophy. The patient made an uneventful recovery.

**CASE 4.** A man, aged 5 years, came to the clinic on August 26, 1940, because of arthritis and the presence of blood in the stools. The small joints were swollen and tenderness was present over most of the joints. Examination of the abdomen did not disclose any abnormality. Proctoscopic examination disclosed external and internal hemorrhoids, grade 1 (on the basis of 1 to 4). Roentgenologic examination of the colon revealed diverticulosis and a polypoid tumor in the midportion of the descending colon.

At laparotomy on September 5, 1940, the descending colon and the first portion of the sigmoid flexure were found to be bound down rather tightly to the posterior portion of the abdominal wall because there was practically no mesentery. A soft nodule could be palpated in the descending colon. The colon was opened and the tumor was removed by dissection. The pathologist reported that the tumor was a submucous lipoma of the descending colon, 2.5 centimeters in diameter. The operative wound became infected but the patient recovered in a month.

**CASE 5.** A man, aged 50 years, came to the clinic on September 6, 1940, and stated that for the past 15 years he had had attacks of generalized, shifting,

transient abdominal pain that had not been associated with nausea or vomiting and had not given evidence of any symptoms referable to the intestinal tract. The attacks had occurred once or twice a year and had lasted from 1 to 3 days. He had found that a bland type of diet would prevent the attacks. The patient also complained of pain in the epigastrium and in the left upper quadrant of the abdomen which was relieved by alkalies and milk.

Physical examination did not reveal any abnormality. Proctoscopic examination disclosed internal and external hemorrhoids. Roentgenologic examination of the stomach did not disclose any abnormality. A similar examination of the gall bladder revealed that this organ contained a calculus but that it was functioning normally. Roentgenologic examination of the colon disclosed a non sessile polypoid tumor which was believed to be situated in the descending colon near its junction with the sigmoid flexure. The roentgenologist expressed the opinion that the tumor might be a lipoma.

Exploratory operation was performed on September 14, 1940. The tumor was found to be situated at the junction of the descending colon and sigmoid flexure. It was removed through a transverse incision in the colon. The pathologist reported that the tumor was a submucous lipoma of the sigmoid flexure, 3 centimeters in diameter.

The patient was in good condition when he was discharged on October 7, 1940. In a letter dated November 22, 1940, he stated that he was in good health.

**CASE 6.** A man, aged 43 years, came to this clinic on September 5, 1941. About a year previously he had begun to have attacks of cramping pain in the right upper quadrant of the abdomen. These attacks had occurred about once a week, had lasted from 1 to 3 minutes, and then had terminated suddenly. Although they had occurred at almost any time, they had had a tendency to start after meals. Four months before the patient came to the clinic, the frequency of the attacks had increased so that they had been present every day and had lasted about an hour during which the pain occurred at intervals of 2 to 4 minutes. The pain sometimes had awakened the patient at night and it sometimes had been present every half hour during the day. It was relieved by a bowel movement or by the passage of flatus. It usually was localized in the right upper quadrant of the abdomen but it sometimes extended to the left scrotal region. There had not been any diarrhea and the patient never had seen any blood in the stools.

Physical examination revealed a tender movable mass in the right upper quadrant of the abdomen. Roentgenologic examination disclosed ileocolic intussusception. The intussusception first was observed in the middle of the transverse colon but in the course of the examination it was reduced as far as the hepatic flexure. At the completion of this part of the examination, the intussusception involved only the ileum and cecum. The roentgenologist reported

that there probably was a tumor or Meckel's diverticulum in the distal portion of the ileum.

On September 10, 1941, an exploratory laparotomy revealed intussusception of the cecum and ascending colon into the transverse colon. A tumor appeared to be attached to the first portion of the ascending colon by a thick pedicle. Because of the redundancy caused by repeated intussusception, about 4 inches (10 cm.) of the terminal portion of the ileum, the cecum and the ascending colon were excised. The continuity of the intestine was re-established by end-to-end anastomosis. The pathologist reported that the tumor was an ulcerating submucous lipoma of the cecum. It measured 6.5 by 5 by 5 centimeters and was situated opposite the ileocecal valve. In June, 1943, the patient reported that he was in good health.

**CASE 7.** A married woman, aged 48 years, registered on February 2, 1942, because of recurring attacks of colicky cramp which had been present for 4 months. The pain was situated in the right half of the abdomen and extended to the lower part of the right side of the thorax. It was not related to the ingestion of food or fluids but occurred in regular rhythm and kept her up at night; it lasted from 2 to 5 minutes and then disappeared for several minutes. It was relieved by bowel movements. In the past 4 months the number of bowel movements had increased from one to two a day and the stools were softer than they had been previously. The patient was nauseated and belched frequently. There was no blood in the stools.

Physical examination disclosed tenderness in the right upper quadrant of the abdomen. Proctoscopic examination disclosed small external and internal hemorrhoids. Roentgenologic examination of the colon disclosed a polypoid tumor about 5 centimeters in diameter which appeared to be attached to the lateral wall of the first part of the ascending colon by a pedicle. When the roentgenologic examination of the colon was started the ascending colon was found to be invaginated into the transverse colon as far as the midportion of this segment.

Laparotomy was performed on February 7, 1943. A tumor about the size of a hen's egg was found in the ascending colon. Although the tumor appeared to be benign it had caused the terminal portion of the ileum, the cecum and the ascending colon to become invaginated into the transverse colon as far as the midportion of this segment. The last 3.5 inches (8.9 cm.) of the ileum, the cecum and the ascending colon were excised and the continuity of the intestine was re-established by end-to-end anastomosis. The operation was completed in a single stage. The pathologist reported that the tumor was a submucous lipoma of ascending colon which measured 5 by 5 by 4 centimeters. An ulcer 3.5 centimeters in diameter was found on the overlying mucosa. The patient made an uneventful recovery.

**CASE 8.** A man, aged 53 years, came to the clinic on January 25, 1943, because of abdominal cramps and diarrhea which had been present for 3 weeks. He

also had discovered a painful mass in the left lower part of the abdomen. He had lost 10 pounds (4.5 kgm.) in the previous 6 months and had had occasional attacks of gaseous distention which had been relieved by the passage of flatus. Two weeks before admission he had had an attack of diarrhea and had noticed blood in the stools.

Physical examination revealed a fixed, slightly tender mass in the sigmoid flexure just above the brim of the pelvis. This mass was about 12 centimeters long. Proctoscopic examination revealed hemorrhoids. Roentgenologic examination disclosed a polypoid lesion of the descending colon at the level of the crest of the ilium. It was felt that the lesion probably was a carcinoma.

On January 29, 1943, exploratory laparotomy revealed a lesion in the descending colon just below the splenic flexure. The involved segment of the colon was thickened and congested; its appearance suggested intussusception or intestinal obstruction. The colon was exteriorized over a three-bladed clamp and about half of the transverse colon and most of the descending colon were excised. The pathologist reported that the tumor was a submucous lipoma of the descending colon which measured 4 by 3 by 2 centimeters and had caused intussusception into the sigmoid flexure. An ulcer which measured 3 by 2 centimeters was present on the surface of the tumor. The colonic stoma was closed on March 9, 1943.

The patient returned to the clinic for examination of his right knee on June 11, 1946, and at that time he did not have any symptoms referable to the intestinal tract.

**CASE 9.** A married woman, aged 46 years, came to the clinic on April 7, 1943. She had undergone appendectomy in 1910. Three years before admission pain had developed in the epigastrium and had extended to the right lower quadrant of the abdomen. It had been aggravated by jolting and had been rather constant until a regimen for cholecystic disease had caused it to disappear. However 3 months before she came to the clinic she again experienced epigastric pain which extended to the entire right side of the abdomen; it was a dull type of pain which usually occurred before meals but sometimes lasted for 24 hours. She complained of gaseous distention of the stomach which was aggravated by the ingestion of fried foods and was relieved by belching. She passed considerable flatus with her bowel movements. She did not give any history of pain in the right shoulder or jaundice, acholic stools, nausea or vomiting.

Physical examination revealed epigastric tenderness and an elongated mass in the right upper and lower quadrants of the abdomen. Mass extended upward to a point just above the umbilicus; it was tender, moved with respiration and had the consistency of rubber. Roentgenologic examination of the colon revealed a polypoid lesion of the cecum which was about 5 centimeters in diameter. Intussusception was found in the region of the hepatic flexure of the colon but the invagination was reduced easily.

by manipulation while the opaque enema was being administered. Roentgenologic examination of the stomach and gall bladder did not disclose any abnormality of these organs.

April 13, 1943, exploratory laparotomy revealed a tumor which appeared to be situated in the ascending colon near the cecum and which had caused intussusception. The terminal portion of the ileum, the cecum and the remainder of the right half of the colon were excised and the continuity of the intestine was re-established by side-to-side anastomosis. The pathologist reported that the tumor was a submucous lipoma of the cecum. It was about 5 centimeters in diameter and the overlying mucosa was ulcerated. Situated near the tumor were several pseudopolyps which varied in size from 5 millimeters to 1 centimeter in diameter. The patient's convalescence was uneventful.

CASE 10. A married woman, aged 41 years, came to the clinic on June 6, 1943. She had undergone appendectomy in 1918. In October, 1942, she first had noticed burning pain in the epigastrium 1 hour after meals. It had been relieved by vomiting and by the taking of bicarbonate of soda. Although roentgenologic examination had not disclosed any evidence of peptic ulcer, an ulcer regimen had been instituted. In November, 1942, the patient had had an attack of diarrhea which had lasted 1 month and during which time she had passed from 8 to 10 bloody stools during the day and from 3 to 4 during the night. A similar attack had occurred in February, 1943, but had disappeared in about 3 weeks, although the diarrhea had recurred about 2 weeks later and had persisted until the patient came to the clinic. Cramps in the lower part of the abdomen had accompanied each bowel movement. When diarrhea had not been present, the patient's bowels had moved only with the aid of a cathartic and the stools had been the size of a pencil.

On examination the abdomen was slightly distended and the left lower quadrant was tender. Palpation also disclosed a small mass in this quadrant. Proctoscopic examination disclosed hemorrhoids and a small rectal polyp; the polyp was fulgurated. Roentgenograms of the stomach and gall bladder showed normal conditions. Roentgenologic examination of the transverse colon disclosed a large polypoid tumor in this portion of the colon situated near the hepatic flexure. The roentgenologist expressed the opinion that there might possibly be several other smaller polypoid tumors, both proximal and distal to the large tumor. The smaller polyps could not be demonstrated satisfactorily by roentgenoscopy because of the presence of intussusception which could not be reduced during the examination.

On June 11, 1943, excision of the terminal portion of the ileum, the cecum and the right half of the colon was performed. The continuity of the intestine was re-established by side-to-side anastomosis. The pathologist reported that the tumor was a pedunculated submucous lipoma which measured 8 centimeters in diameter. An ulcer 5 centimeters in

diameter was present on the surface of the tumor. The patient was in good health when she was dismissed on June 30, 1946.

CASE 11. A man, aged 53 years, registered on June 19, 1943, because of diarrhea of 2 weeks duration and of red blood in the stools 7 days before admission. His appendix had been removed in 1917. During the year before he came to the clinic he had been receiving prostatic massage for aching pain in both groins. The massage was continued although the pain had subsided in the past 6 months. Since December, 1942, he had had frequent attacks of mild abdominal cramps which always had been relieved by a bowel movement, the stools having been formed and no blood having been noted. Diarrhea, with 4 to 6 bowel movements daily had developed 2 weeks prior to admission and medical treatment for the condition had been followed by obstipation. Seven days before registration there had been marked rectal bleeding which had persisted for 36 hours. Two days later, roentgenologic examination had disclosed a lesion of the sigmoid. Three days before he came under our care, severe abdominal cramps developed which were relieved by the onset again of diarrhea.

On physical examination, deep tenderness was noted in the left groin. Proctoscopic examination of the distal 24 centimeters of the intestine revealed that the upper limit of this portion of the intestine was moderately fixed to surrounding structures and that it was angulated anteriorly. Internal hemorrhoids, grade 1+ were present. Roentgenologic examination disclosed a polypoid tumor at the junction of the descending colon and the sigmoid flexure which had a tendency to cause intussusception. The retrograde flow of barium was partially obstructed.

Laparotomy was performed on June 26, 1943, at which time the polypoid tumor was found in the upper part of the sigmoid flexure. Because it was felt that the tumor might be malignant, about 10 inches (25.4 cm.) of the sigmoid flexure was excised. The continuity of the intestine was re-established by end-to-end anastomosis over a three-bladed clamp. The pathologist reported that the tumor was a pedunculated submucous lipoma of the sigmoid flexure 4 centimeters in diameter. An ulcer 3 centimeters in diameter was found on the surface of the tumor. Ten days after the operation the patient passed a small renal calculus.

On September 16, 1944, the patient returned to the clinic for re-examination. At that time roentgenologic examination of the colon and terminal portion of the ileum did not disclose any abnormality.

CASE 12. A married woman, aged 61 years, came to the clinic on September 22, 1943, because of a painful swelling of the right knee. She was troubled with constipation but she occasionally passed 2 or 3 loose stools daily. She also complained of gaseous distention of the stomach and of belching. Physical examination disclosed tenderness over the cecum and a questionable mass in this region. Roentgenologic examination revealed a polypoid tumor in the right portion of the colon.

Exploratory laparotomy was performed on October 5 1943. A tumor was found in the ascending colon just above the cecum. The tumor which was situated between the muscular and mucosal layers of the colon was removed by dissection. The pathologist reported that the tumor was a submucous lipoma. It measured 8 by 5 by 2 centimeters. The patient made an uneventful recovery and was dismissed from our care on October 29 1943.

The patient returned in January 1946 because of intermittent aching and swelling in the right side of the abdomen. Physical examination did not disclose any abnormality and roentgenograms of the stomach and colon showed normal findings.

**CASE 13.** A married woman aged 58 years came to the clinic on October 26 1944 because of constipation which had been present for 4 years and which had increased in severity. She said that the constipation could be relieved with enemas. On several occasions the bowel movements had been preceded by the passage of a small amount of mucus and 5 months before admission a small amount of blood had been passed in the stool.

Physical examination revealed an adenoma of the right lobe of the thyroid gland and a palpable mass in the left side of the epigastrium. Roentgenologic examination disclosed a polypoid tumor in the mid portion of the descending colon which had caused intussusception.

On November 8 1944 the involved portion of the descending colon was excised and the continuity of the intestine was re-established by end-to-end anastomosis. The pathologist reported that the tumor was a submucous lipoma which measured 5 centimeters in diameter. An ulcer 4 centimeters in diameter was present on the mucosal surface of the tumor.

**CASE 14.** A married woman aged 50 years registered on November 2 1944. Six weeks previously she had felt a tumor in the middle of the abdomen. Roentgenologic examination of the kidneys and gall bladder had failed to disclose any abnormality. The tumor had disappeared after castor oil had been administered in the preparation of the patient for roentgenologic examination of the colon. She subsequently had felt the tumor on 3 or 4 occasions but it had disappeared after she had taken an enema or a dose of castor oil. She had indigestion and said that she was passing an increased amount of flatus. She always had been constipated.

Physical examination revealed a lipoma the size of an egg on the posterior wall of the thorax. Roentgenologic examination of the colon disclosed a polypoid tumor about 5 centimeters in diameter. The tumor appeared to be situated in the descending colon and at times had caused the ascending colon to become invaginated into the transverse colon. Proctoscopic examination did not reveal any abnormality.

On November 14 1944 excision of the cecum and several centimeters of the ileum was performed and the continuity of the intestine was re-established by side-to-side anastomosis. The pathologist reported



Fig. 1. Case 16. Pedunculated submucous lipoma.

that the tumor was a pedunculated submucous lipoma 4 centimeters in diameter which was situated at the juncture of the cecum and the ascending colon. An inflamed ulcer 1 by 1 by 5 centimeters was present on the surface of the tumor.

The patient was in good health when she returned to the clinic for examination on October 12 1945.

**CASE 15.** A man aged 62 years registered on September 18 1946. Tonsillectomy had been performed in 1928 and a rectal fistula had been excised in 1932. Constipation had been present intermittently for a year and had been associated with pain in the left lower quadrant of the abdomen and with the passage of bright red blood in the stools. However for one period of 3 months he had not passed any blood. He had not had any diarrhea or obstipation nor had he lost any weight.

Physical examination did not reveal any abnormality. Proctoscopic examination disclosed hemorrhoids grade 1. Roentgenologic examination disclosed a large polypoid tumor in the descending colon just above the level of the crest of the ilium. Since the tumor was radiolucent the roentgenologist expressed the opinion that it might be a lipoma.

Laparotomy was performed on October 18 1946. A tumor was found in the wall of the descending colon just above the level of the anterior superior spine of the ilium. By means of an incision in the serous and muscular coats of the colon it was possible to remove the tumor without opening the lumen of the intestine. The pathologist reported that the tumor was a submucous lipoma of the descending colon which measured 5 by 3 by 2 centimeters. The postoperative convalescence was uneventful.

**CASE 16.** A man aged 55 years came to the clinic on June 27 1944 because of hemorrhoids. Proc-



Fig. Case 9. Lipoma with laceration of overlying mucous membrane.

toscopic examination revealed in addition to the hemorrhoids 3 small polyps in the lower 10 centimeters of the rectum. These tumors were fulgurated. Roentgenologic examination disclosed a sessile polypoid tumor in the ascending colon about 3.5 centimeters in diameter. Removal of the tumor was advised but the patient returned to his home.

He returned to the clinic on October 7, 1946 and at that time he did not have any symptoms that were referable to the gastrointestinal tract. Examination of the abdomen did not reveal any abnormality. Proctoscopic examination disclosed only polyps in the last 3 centimeters of the rectum. These tumors were fulgurated. Roentgenologic examination again revealed the polypoid tumor in the ascending colon which appeared at that time to be slightly larger than it had at the time of the patient's previous examination here.

Laparotomy was performed on November 21, 1946. The patient was rather obese and because of the presence of a large amount of fat and many epiploic tags, it was not possible to determine whether or not a polyp was present in the colon. A transverse incision was made in the hepatic flexure and two Deaver retractors were inserted. A yellow polypoid tumor then popped out of the incision. It was freely movable beneath the mucous membrane. It was squeezed from its attachment; the stalk was transfixed and ligated with a double cotton suture and the tumor was excised. The pathologist reported it to be a pedunculated submucous lipoma which measured 4 by 5 by 3 centimeters and weighed 33 grams (Fig. 1).

In letter dated December 28, 1946 the patient stated that he was in good health.

**CASE 17.** A married woman, aged 49 years, came to the clinic in January, 1947, complaining of spells of extreme weakness and heaviness which were thought to be functional and on a menopausal basis. She complained of gas at the time of these attacks but did not have nausea or vomiting. Some blood had been noted occasionally in the stools.

On examination the patient was found to have moderate hypertension; the blood pressure ranged between 150 and 170 millimeters of mercury systolic and more than 90 diastolic. On proctoscopic examination a small polyp was found 8 centimeters from the dentate margin and this was fulgurated. Roentgenographic examinations of the stomach and gall bladder revealed nothing significant but a spot film roentgenogram of the colon revealed a sessile polypoid lesion about 2 centimeters in diameter in the cecum just below the ileocecal valve. The growth was not visible in the ordinary roentgenogram.

At operation in February, 1947, appendectomy and transcolonic removal of a lipoma, 2.5 centimeters in diameter of the cecum were performed. No other abnormality was found except some fibroids of the uterus.

The convalescence was without incident and the patient was dismissed from our care on the twelfth postoperative day.

**CASE 8.** A woman, aged 66 years, came to the clinic in March, 1947, complaining of "gnaug epigastric distress" which had been present for a period of 8 to 10 years. Her gall bladder and appendix had been removed in 1938. She had had chronic constipation for which she habitually had used cathartics and enemas; there had not been any blood in the stools. She had not had nausea or vomiting. Her weight and general physical appearance were normal and physical examination gave essentially negative results except for mild tenderness over the upper part of the abdomen. Roentgenographic examination revealed a large diverticulum of the duodenum and some diverticulosis of the colon but did not disclose any other abnormality in the colon or terminal portion of the ileum.

Surgical treatment was advised for the duodenal diverticulum and, accordingly, on March 17, 1947, resection was performed for the duodenal diverticulum. Further exploration of the abdomen revealed what appeared to be enteritis of the terminal portion of the ileum and a palpable mass in the cecum. Right hemicolectomy was performed with removal of the distal 34 feet (76 cm.) of ileum, the cecum, ascending colon and hepatic flexure. An end-to-end ileo-transverse colostomy was done.

Examination of the removed tissue disclosed multiple nonspecific inflammatory ulcers, in various stages of healing, in the terminal 35 centimeters of the ileum; perileitis had caused angulation of the ileum above the ileocecal valve and had produced mechanical obstruction. Diverticulosis was found in the colon and a submucous lipoma, 5 centimeters in diameter, was present in the ileocecal valve.

Intermittent episodes of the intussusception might be an explanation of some of the patient's symptoms.

**CASE 10.** A married woman, aged 53 years, came to the clinic in December, 1947, complaining of discomfort in the left lower quadrant of the abdomen of more than 3 years' duration. She had been very ill 3 weeks before admission with intermittent cramps

in the left lower abdominal quadrant nausea and vomiting. Bright red blood had been passed in the stool. A mass had been discovered and she had had signs and symptoms of obstruction. She had been hospitalized and a presumptive diagnosis of carcinoma of the colon had been made. Under care the attacks had lessened in severity and she decided to come to the Mayo Clinic for treatment. The patient stated that she had lost 20 pounds (9.1 kgm) in the past year and that she was having a constant dull ache with intermittent crampy pains. A smooth tender mass was found in the left side of the abdomen. On rectal examination red blood was noted but there was no mass. Proctoscopic examination for a distance of 26 centimeters also yielded normal findings. A roentgenographic examination revealed an obstructing lesion in the upper portion of the descending colon; it was not possible to force the barium above the lesion, the exact nature of which was indeterminate. Obstruction of the bowel above this level was apparent; there was a large amount of feces in the ascending colon and transverse colon and a loop of small intestine was distended with gas. The lesion did not appear to have undergone malignant change.

Operation was performed on December 20, 1947, at which time an intussuscepting lesion was found in the descending colon. The intussusception was reduced and an incision was made in the colon near the base of the palpable polypoid growth. A lipoma which measured 7.5 by 5.5 by 5 centimeters with ulceration of the overlying mucous membrane (Figs. 2 and 3) was removed and the colonic incision was closed.

The patient's convalescence was uneventful and she was dismissed from the hospital on the tenth postoperative day.

#### COMMENT

In the 19 cases which we have reported the lipomas were distributed rather evenly in the different segments of the large intestine. The site of involvement was as follows: cecum in 6 cases, ascending colon in 4 cases, hepatic flexure in 1 case, transverse colon in 1 case, descending colon in 5 cases, and the sigmoid flexure in 2 cases.

The differential diagnosis of lipoma of the large intestine and carcinoma of the large intestine is rather difficult. In the 19 cases reported herein the youngest patient was 41 years old and the oldest patient was 66 years old. The average age of the 19 patients was 52 years, which closely approximates the age at which carcinoma of the colon is most likely to occur. Twelve of the 19 patients were women and 7 were men.

Although the symptoms of submucous lipoma closely resemble those of carcinoma, cer-



Fig. 3. Case 19. Same as Figure 2. Lipoma opened.

tain rather subtle differences become evident when a group of cases of submucous lipoma are compared with a group of cases of carcinoma. It should be emphasized, however, that these differences are of doubtful value in trying to distinguish these two lesions in an individual case. The symptoms of submucous lipoma may be of much longer duration than those of carcinoma. In the 19 cases which we have reported the longest duration of symptoms was 15 years and the shortest was 2 weeks. One patient did not have any symptoms that were referable to the gastrointestinal tract. Bleeding may or may not be a sign of lipoma of the colon. In 9 of these 19 cases blood in the stools had been noted. Anemia was by no means a prominent finding, certainly not comparable to the extent that it is found in the presence of malignant lesions.

Pain usually intermittent and often of cramping type was present in 12 of the 19 cases, most probably the result of intussusception. Intussusception tends to occur when the lipoma exists in a mobile portion of the colon and for this reason intussusception occurs more commonly, although not exclusively, when the lipomas are located in the right portion of the large bowel.

If one considers the cecum, ascending colon, hepatic flexure and the first portion of the transverse colon as the right portion of the colon, in 12 of the 19 cases the lipoma was situated in this segment and in 8 of these 12 cases a one stage resection was performed. In



Fig. 2. Case 9. Lipoma with laceration of overlying mucous membrane.

oscopic examination revealed, in addition to the hemorrhoids 3 small polyps in the lower 10 centimeters of the rectum. These tumors were fulgurated. Roentgenologic examination disclosed a sessile polypoid tumor in the ascending colon about 2.5 centimeters in diameter. Removal of the tumor was advised but the patient returned to his home.

He returned to the clinic on October 7, 1946 and at that time he did not have any symptoms that were referable to the gastrointestinal tract. Examination of the abdomen did not reveal any abnormality. Proctoscopic examination disclosed tiny polyps in the last 3 centimeters of the rectum. These tumors were fulgurated. Roentgenologic examination again revealed the polypoid tumor in the ascending colon which appeared at that time to be slightly larger than it had at the time of the patient's previous examination here.

Laparotomy was performed on November 1, 1946. The patient was rather obese and because of the presence of a large amount of fat and many epiploic tags it was not possible to determine whether or not a polyp was present in the colon. A transverse incision was made in the hepatic flexure and two Deaver retractors were inserted. A yellow polypoid tumor then popped out of the incision. It was freely movable beneath the mucous membrane. It was squeezed from its attachment, the stalk was transfixed and ligated with double cotton suture and the tumor was excised. The pathologist reported it to be a pedunculated submucous lipoma which measured 4 by 5 by 5 centimeters and weighed 53 grams (Fig. 1).

In a letter dated December 8, 1946 the patient stated that he was in good health.

CASE 17. A married woman aged 49 years came to the clinic in January, 1947 complaining of spells of extreme weariness and heaviness which were thought to be functional and on a menopausal basis. She complained of gas at the time of these attacks but did not have nausea or vomiting. Some blood had been noted occasionally in the stools.

On examination the patient was found to have moderate hypertension; the blood pressure ranged between 150 and 170 millimeters of mercury systolic and more than 90 diastolic. On proctoscopic examination a small polyp was found 18 centimeters from the dentate margin and this was fulgurated. Roentgenographic examinations of the stomach and gall bladder revealed nothing significant but a spot-film roentgenogram of the colon revealed a sessile, polypoid lesion about 5 centimeters in diameter, in the cecum, just below the ileocecal valve. The growth was not visible in the ordinary roentgenogram.

At operation in February, 1947, appendectomy and transcolonic removal of a lipoma 2.5 centimeters in diameter of the cecum were performed. No other abnormality was found except some fibroids of the uterus.

The convalescence was without incident and the patient was dismissed from our care on the twelfth postoperative day.

CASE 8. A woman aged 66 years, came to the clinic in March, 1947, complaining of gnawing epigastric distress which had been present for period of 8 to 10 years. Her gall bladder and appendix had been removed in 1928. She had had chronic constipation for which she habitually had used cathartics and enemas; there had not been any blood in the stools. She had not had nausea or vomiting. Her weight and general physical appearance were normal and physical examination gave essentially negative results except for mild tenderness over the upper part of the abdomen. Roentgenographic examination revealed a large diverticulum of the duodenum and some diverticulosis of the colon but did not disclose any other abnormality in the colon or terminal portion of the ileum.

Surgical treatment was advised for the duodenal diverticulum and, accordingly on March 17, 1947, resection was performed for the duodenal diverticulum. Further exploration of the abdomen revealed what appeared to be enteritis of the terminal portion of the ileum and a palpable mass in the cecum. Right hemicolectomy was performed with removal of the distal 3½ feet (76.5 cm.) of ileum, the cecum, ascending colon and hepatic flexure. An end-to-end ileo-transverse colostomy was done.

Examination of the removed tissue disclosed multiple nonspecific inflammatory ulcers in various stages of healing in the terminal 5 centimeters of the ileum; perileititis had caused angulation of the ileum above the ileocecal valve and had produced mechanical obstruction. Diverticulosis was found in the colon and a submucous lipoma, 1.5 centimeters in diameter was present in the ileocecal valve.

Intermittent episodes of the intussusception might be an explanation of some of the patient's symptoms.

CASE 10. A married woman aged 52 years, came to the clinic in December, 1947, complaining of discomfort in the left lower quadrant of the abdomen of more than 5 years' duration. She had been very ill 2 weeks before admission with intermittent cramps

## CARCINOID TUMORS OF THE INTESTINE

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**A**RGENTAFFIN tumors of the intestinal tract are a challenge to modern surgery because of their rarity, their altered behavior in different anatomical locations and because in only an occasional instance has a correct diagnosis been made preoperatively. The early writers stressed the association of these tumors with obliterative appendicitis and noted that they did not infiltrate extensively and only rarely metastasized to regional lymph glands. In spite of these observations no suspicion was aroused that these were not ordinary adenocarcinomas. In 1888 Lubarsch reported 2 cases wherein multiple small separate tumors were noted in the submucosa of the terminal ileum. These consisted of columns and masses of cells which were distinctly unlike those of ordinary carcinoma. No true glandular formation was present although degeneration of some of the central cells sometimes produced a pseudoglandular appearance. Although he was well aware that these were not the usual type of carcinoma, the cases were reported as primary carcinoma of the ileum.

Oberndorfer in 1907 clarified the polemic aspects of the problem by showing that there occurred in the gastrointestinal tract in addition to the ordinary carcinomas a superficially related tumor for which he coined the term carcinoid. The important features of the latter were their localized nature and relative benignity as shown by their slow growth and lack of infiltration, the absence of metastatic spread by lymph and vascular channels, the fact that more than one tumor was often present, and their histological appearance. Oberndorfer's ideas were generally accepted but even as late as 1921 histologically similar tumors were being reported as spheroid-cell carcinoma (23).

In 1914 Gosset and Masson showed that the cells of the intestinal chromaffin tissue when stained by ammoniacal silver salts exhibited

black granules in their cytoplasm. By this method they were able to demonstrate similar cells lying among the ordinary columnar cells near the bases of the crypts of Lieberkuehn. Using similar stains they showed that carcinoid tumors were composed of cells of the same type. They therefore added the term argentaffin to these tumors. Although Masson's work is not accepted completely, there is almost general agreement that carcinoid tumors originate from the Kulitschitzky cells of the crypts of Lieberkuehn. They probably should be called argentaffinomas but the term carcinoid is so deeply entrenched in medical literature that its continued use seems justifiable.

The Kulitschitzky cells are more common in the appendix than elsewhere in the intestine which accounts for the high incidence of carcinoid tumors in that organ. Their incidence

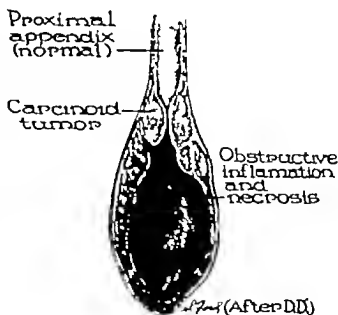


Fig. The characteristic yellow submucosal tumor may obliterate the lumen and cause obstructive inflammation and necrosis of the distal appendix. The irregular lobula non causus by the fibrous tissue septa is evident. The overlying mucosa is usually intact.

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only 4 of the 12 were the lipomas removed transcolonicly.

In 3 of the 7 cases in which the lipoma was situated in the left portion of the colon segmental resection was required. In the remaining 4 cases local excision of the lipoma was performed.

A total of 11 cases out of 19 in which extensive resection for lipoma was required might appear on the surface to be a high incidence. However the difficulties encountered in making an unequivocal preoperative diagnosis, despite the improvement in roentgenologic studies, and the extensiveness of the

process of intussusception so often encountered at the time of operation play a part in influencing the surgeon to employ a more radical operation than otherwise might be indicated for a benign condition. It is interesting and significant also that despite such major surgical procedures no deaths occurred.

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TABLE I—CLINICAL RÉSUMÉ OF CARCINOID TUMORS OF THE APPENDIX SEEN AT THE UNIVERSITY OF CALIFORNIA HOSPITAL 1927-1947

Case	Age	Sex	Involvement			Acute inflammation	Sub-mucosal fibrosis	Normal appendix
			Muscularis	Serosa	Meso-appendix			
	8	M		X		X		
	60	M		X				X
1	65	M		X			X	
	38	F	X				X	
5		F	X				X	
6	5	F	X					X
7		F			X			X
8	3	F	X			X		
	1	F	X					X
	3	F		X		X		
	3	F		X		X		
Average age 36.5			5 cases 45.5%	5 cases 45.5%	Case 100%	4 cases 40.0%	3 cases 30.0%	4 cases 40.0%

Table I. Appendiceal carcinoids are most often seen in young females. Growth by continuity involves successively the muscularis, the serosa, and occasionally the meso-appendix. The tumors are encountered about equally in the normal and in the acutely or chronically diseased appendix.

cells often extend beyond this, however and cell nests may be seen in the muscularis the subserosa the serosa or even in the adjacent peritoneum or mesentery (4)

The cells have round distinct nuclei but often the cytoplasmic borders are ill defined. They bear no resemblance to the ordinary columnar or mucous cells lining the intestinal glands. There is no true glandular formation. Occasionally the central portions of the cell masses exhibit a vacuole which contains an eosin staining material. This formation may closely simulate the rosettes which occur in the neuroblastomas (Fig 2)

Although the characteristic feature of the tumor as originally described was its apparent benignity it is now generally agreed that malignant change may occur. Spread occurs by continuity and contiguity of tissue as well as by invasion of lymph and vascular channels. In the small intestine such a change is rather commonly encountered. Appendiceal carcinoids however are but rarely malignant.

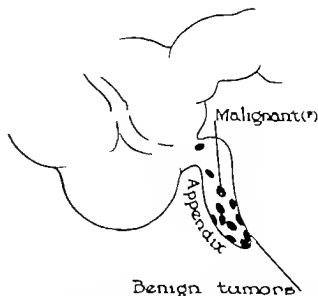


Fig 3. Nine (82 per cent) of the 11 appendiceal carcinoids were located in the distal portion of the appendix and only 2 in the proximal extent. Widespread abdominal involvement in 1 case may have been due to a carcinoid tumor originating in the appendix.

In 1926 Stewart and Taylor reported 1 case and could find only 8 others cited in the literature. Wyatt recently has been able to collect another 5 cases.

It is becoming apparent that the behavior of the carcinoid tumors is quite different depending upon the site of the primary growth. Those arising in areas other than the appendix may appear as metastasizing malignant growths requiring radical treatment.

In the 21 year period from 1927 through 1947 19 patients were treated at the University of California Hospital for carcinoid tumors of the gastrointestinal tract. Eleven were in the appendix and 8 in the small bowel. The behavior of the tumor in each group is so different that it seems best to discuss them separately.

#### CARCINOID TUMORS OF APPENDICEAL ORIGIN

Appendiceal carcinoids occur usually in young people and are more commonly seen in females. The oldest patient in the University of California group was 65 the youngest 13 and the average age was 29.5 years. All were treated by simple appendectomy. One tumor was located in the proximal end 1 in the mid portion and the remaining 9 (82 per cent) were in the tip of the appendix (Fig 3). Five of the carcinoids involved the muscularis

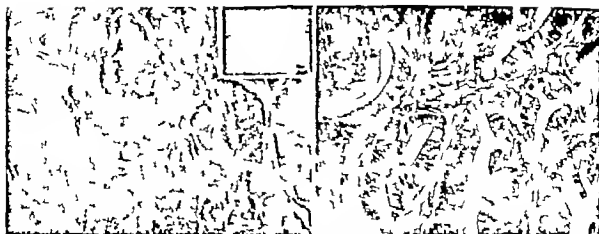


Fig. The columns and masses of cells of the carcinoid tumor a, left are distinctly unlike those of the more common adenocarcinoma, b. There is no true glandular formation. The cells are of quite uniform size and are surrounded

by rather dense fibrous tissue stroma which tends to be condensed at the borders of the tumor. The cells have round, distinct nuclei but the cellular borders are often ill defined, a, insert.

is next highest in the terminal ileum as is the incidence of carcinoids. The neoplasm grows but slowly and is often unrecognized because of its small size. In a small blind tube like the appendix it is more readily discovered than in the ileum. Of greater importance however is the possibility of appendiceal obstruction and the consequent inflammation by which attention may be drawn to it.

In spite of the rather extensive literature concerning them such tumors are rare. Although 90 per cent of all neoplasms found in the appendix are carcinoids, Foot states that only 0.46 per cent of appendices removed for appendicitis contain carcinoid tumors. A single tumor is usually present most frequently in the tip. In most of the reported series, from 70 to 80 per cent occurred in this region. Elsewhere in the gastrointestinal tract multiple tumors are more commonly encountered. After the appendix the terminal ileum is the next most common location though they may occur anywhere in the gastrointestinal tract from the cardia to the rectum and constitute about 20 per cent of all malignant tumors arising in the small intestine.

Characteristically the tumor consists of a yellow nodule of varying size which occupies the submucosa. The overlying mucous membrane is usually intact although occasionally some superficial ulceration occurs. The nodule has a firm rubbery consistency and may ex-

tend through the muscularis to involve the serosa. The cut surface of the tumor often exhibits irregular fibrous bands dividing it into more or less separate yellow nodules. In the appendix, as it increases in size the tumor may reach the opposite wall and cause obstruction of the lumen (Fig. 7). In other instances it appears as an annular thickening of the appendiceal wall frequently a centimeter or more in length which completely obliterates the lumen. In either event an attack of acute obstructive appendicitis may occur. It should be noted that the tumor obliterates the lumen not by contraction of the fibrous stroma but by its bulk. At the opposite extreme, the lesion may be so small that it is found only on microscopic examination. Elsewhere in the gastrointestinal tract, where the lesions are more often multiple, the growths usually project into the bowel lumen as smooth polypoid masses over which the mucosa is intact. A rather intense fibroplasia accompanies the invasion of the mesentery resulting in kinking of the bowel by contraction of the fibrous tissue. Occasionally the tumor assumes a ring-like constriction similar to that of adenocarcinoma.

Microscopically the tumor consists of clumps and masses of large spheroidal cells lying in a fibrous stroma. There is usually some condensation of the nonstriated muscle fibers at the periphery of the tumor in the fibrous capsule which tends to form. The

TABLE II—CLINICAL RESUMÉ OF MALIGNANT CARCINOIDS SEEN AT THE UNIVERSITY OF CALIFORNIA HOSPITAL 1927 THROUGH 1947

Case Age Sex	Symptoms and signs	Primary lesion	Metastatic deposits	Operative treatment	Postoperative treatment	Sequence
1 35 F	Abdominal pain, diarrhea, wt. loss of 50 pounds, and partial small bowel obstruction	Upper portion of ileum	Mesenteric and periaortic nodes	Biopsy and entero-enterostomy	Large bowel obstruction requiring transverse colectomy yrs. later	Died 44 mos. after enteroenterostomy with generalized abdominal metastases
2 31 F	Diarrhea, weight loss, right lower quadrant mass	Undetermined, possibly appendiceal	Omentum, peritoneum, large and small bowel, retroperitoneal tissues, pelvis	Biopsy	None	Died 6 months post operative) Generalized abdominal metastases
3 60 M	Lower abdominal pain	Terminal ileum	Adjacent mesenteric nodes	Ileocolic resection (with wide margin of mesentery)	None	N. recurrence 7 years (proved at second laparotomy for marginal ulcer)
4 41 M	Dyspepsia, anorexia, blood in stool, mass in left flank	Probably primary in jejunum	Generalized abdominal spread, including liver and spleen	Biopsy	Radiation	Died 3 mos. postoperative with generalized abdominal metastases
5 61 M	Epigastric distress, cramps, vomiting, & loss of 5 pounds. Small bowel obstruction	Terminal ileum	Adjacent mesentery by continuity	Ileotransverse colectomy (tumor not removed)	Biopsy of recurrence in abdominal wall scar	Died 50 mos. post operative with generalized abdominal metastases
6 64 F	Diarrhea, cramps, small bowel distention. Weight loss	Undetermined, probably terminal ileum	Mesenteric nodes, periaortic nodes, liver	Biopsy	None	Died 10 days post operative.
7 60 F	Generalized abdominal pain, diarrhea, and symptoms of small bowel obstruction	Terminal ileum	Cul-de-sac extend ing into vagina	Resection, and lateral abscissomies	Biopsy pelvic mass & irradiation	Died 7 years after original surgery
8 67 M	Diarrhea, intermittent abdominal pain, distention, partial large bowel obstruction	Terminal ileum	Omentum, small bowel, mesentery peritoneum, retroperitoneum, uterine, mammary node	Laparotomy and biopsy	None	Died 8 months after laparotomy

Table II. The average age was 58 years in the 5 males and 3 females in the series. All the tumors were malignant as shown by regional and distant lymphatic and blood borne metastases. Carcinoid tumors should no longer be regarded as clinically silent neoplasms. Operative results

are exceptionally good when it is possible to excise the tumor with a wide margin of gland bearing mesentery. Even in the presence of distant metastases a tendency toward stabilization of the metastatic deposits is noted when the primary growth is removed.

of malignant carcinoid tumors produced clinical symptoms although the majority of authors indicate a much lower percentage. It is becoming apparent that no longer should these neoplasms be regarded as clinically silent lesions. As one would suspect from the rather intense fibroplasia accompanying the mesenteric invasion obstruction results either from the kinking of the bowel by contraction of the mesentery or from intussusception occasioned by the partially intraluminal mass or masses.

Diarrhea was not only common but often severe. It is only rarely that blood can be demonstrated in the stool since the lesions usually do not cause ulceration of the mucosa. Abdominal masses were palpable in 2 patients. Their presence indicates metastatic spread since the primary lesions are almost always small (Table III)

It was true in this series as in other accounts reported in the literature that in spite of the suggestive clinical syndrome the nature of the disease was not suspected before operation. Indeed in some cases the possibility of the existence of a tumor of such nature was not entertained even at surgery. A perusal of the literature reveals that a correct diagnosis of carcinoid tumor of the bowel is made but rarely before operation. In 1942 Miller and Herrmann published the case history of a patient in whom a correct diagnosis was obtained prior to laparotomy. They indicated that in the presence of dilatation of the small bowel from carcinoid tumors a small filling defect associated with kinking of the bowel in that segment could be demonstrated roentgenologically. Coexistence of kinking and tumor of the bowel suggests the diagnosis (Fig 4)

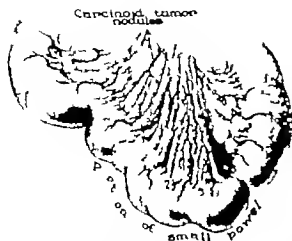


Fig. 4. A dense fibroplasia accompanies the invasion of the mesentery by the carcinoid tumor. The results of mesenteric contraction may produce kinking of the intestine and cause obstruction. In the roentgenographic examination, the kinking of the bowel in association with an intraluminal tumor suggests the diagnosis.

only 5 involved the serosa as well as the muscularis, and 1 extended into the adjacent mesoappendix. The mucosa overlying each was intact. Four of the appendices showed acute inflammation, 3 showed submucosal fibrosis, and 4 were not abnormal. The tumors all had histologically similar characteristics even though one showed invasion of the mesoappendix. Follow up is admittedly inadequate, but there have been no reported sequelae from any of the group of patients (Table I).

Hence appendiceal carcinoids seen at the University of California Hospital conform to the generally accepted clinical and histological characteristics indicated in other reports in the literature. Patients whose appendices contain these tumors usually have no sequelae when the appendix is removed. Cell nests are seen about equally as frequently in the muscularis as in the serosa and if growth by continuity into the mesentery can be considered a criterion of malignancy, then an occasional one is malignant. They are found about equally in the normal and in the acutely or chronically diseased appendix. It is probable that because of the location in a narrow blind-ending tube carcinoids of the appendix produce symptoms relatively early and are therefore removed at

an earlier stage than are similar tumors located elsewhere in the gastrointestinal tract. It may well be that in the appendix, as elsewhere, metastases and therefore malignancy are merely a matter of time. Since attention is called to the appendix early carcinoid tumors may be removed while they are still localized to that organ and for that reason the benignity of appendiceal carcinoids may be more apparent than real. Certainly the growth and histologic characteristics of the tumor in any location are identical.

#### CARCINOID TUMORS OF EXTRA APPENDICEAL ORIGIN

Argentaffin tumors arising elsewhere in the gastrointestinal tract present quite different problems. In this instance the tumor is likely to assume definitely malignant characteristics manifested by metastases, most of which are either to the regional lymph nodes or to the adjacent peritoneum or mesentery.

In the small intestine carcinoid tumors occur mostly in older people and the multiplicity of primary lesions is in contrast to the single primary nodule occurring in the appendix in younger age groups. In those patients in our series having carcinoid tumors of the small intestine the oldest was 67, the youngest 41, and the average age was 58 years (Table II). These observations agree with those of Cooke who in a summary of the literature noted an average age of 57.2 years in patients having malignant carcinoid tumors of the small intestine. These figures contrast markedly with the average age of 39.5 years for patients in whom appendiceal carcinoids were found. Appendiceal carcinoids were more often seen in females while small bowel carcinoids occurred in 5 men and 3 women in this group. This proportion is maintained throughout the literature.

The most common clinically observed syndrome was recurrent attacks of partial intestinal obstruction associated with pain, diarrhea, and weight loss. Five of the 8 patients with small bowel argentaffin tumors manifested this tetrad of symptoms and signs. This proportion is high in comparison with other accounts appearing in the literature. Cooke, collecting informative data from the world literature, noted that about 50 per cent

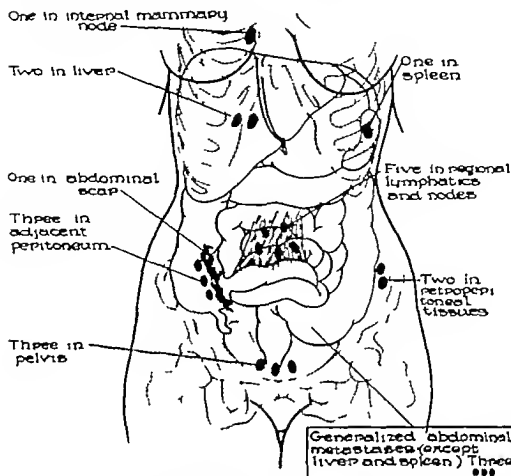


Fig 6 The predominant metastatic spread is regional involving the mesentery, its nodes, and the adjacent peritoneum. Metastatic deposits were encountered in both the liver and spleen. Spread occurs by continuity and contiguity of tissue as well as by invasion of lymph and vascular channels.

all of which manifested the usual criteria of malignancy again forcefully emphasizes that carcinoid tumors of the small bowel should be considered as malignant lesions.

Because of the malignant tendencies of argentaffin tumors treatment should be as radical as is possible. It is fortunate that most of the lesions occur in the terminal ileum so that extensive resections are possible. Horsley has advocated resection of carcinoid tumors even in the presence of metastases and other authors concur for it is not unusual to see metastatic deposits become stationary after the removal of the primary growth. In the 2 cases in our series where wide resection of the tumor and gland bearing area was possible 1 patient has an apparent cure 7 years after surgery as shown by a second laparotomy for treatment of a marginal ulcer the other lived 10 years before succumbing to large pelvic metastases. Even in those cases

in which spread of the tumor made resection impossible the average survival after diagnosis of inoperability was 27 months (excluding the single mortality in the immediate postoperative period) (Table IV). It is apparent that these tumors do truly represent a challenge to modern surgery for with the possibility of early diagnosis combined with

TABLE IV — COMPARATIVE SURVIVAL OF PATIENTS OPERATED UPON

No. of patients	Operative treatment	Average time of survival
	Wide resection of tumor and mesentery	55 years
1	Enterostomy and ileocecectomy	47 months
2	Ileocecectomy only	months

Table IV The excellent prognosis when resection is possible is quite apparent. As indicated in other accounts in the literature simple sidetracking of the lesion is advantageous. The survival time for the 6 patients in whom resection was not possible averaged 27 months.

SYMPTOMS AND SIGNS	Pain							
	Diarrhea							
	Weight loss							
	Intermittent small bowel obstruction							
	Abdominal mass							
	Blood in stool							
	Other							
NO. OF PATIENTS		1	2	3	4	5	6	7

Table III. Pain, diarrhea, and weight loss in association with intermittent episodes of small intestinal obstruction formed the most commonly observed clinical syndrome. The presence of carcinoid tumor of the small bowel should be suspected when this tetrad of symptoms and signs is encountered. Blood is found but rarely in the stool, for these tumors usually do not cause laceration of the mucosa. The presence of palpable abdominal masses usually indicates widespread inoperable abdominal involvement.

The lesions were primary in the ileum in 5 of the 8 patients. In 1 patient although the primary site could not be ascertained with exactitude it was strongly suspected to have been primary in the terminal ileum also. The jejunum was the primary site in 1 patient. In the remaining case, because of the widespread deposits within the abdomen it was utterly impossible to determine the site of origin. Since the distal one-third of the appendix was involved it was the opinion of the operator that the tumor could have arisen from the appendix. Our observations agree with most published reports which indicate that the

terminal ileum is the most common site of origin of carcinoid tumors of the small bowel (Fig 5).

Metastases, present in all patients, occurred most often in the regional lymph nodes, the mesentery and the adjacent peritoneum. Distant metastases were much less frequent, although metastases in the liver and spleen and even within the thorax were noted in this series (Fig 6). Once the tumor reaches the peritoneal surface of the bowel it may implant itself elsewhere just as do other malignant tumors. Anel in 1939, summarized the literature and noted that of the 237 small intestinal carcinoid tumors reported to that date only 24.9 per cent showed evidence of metastases. Dockerty and Ashburn studied 30 carcinoid tumors of the small bowel in which 13 showed undoubted evidence of metastases. This represents a percentage of 43.3 which were malignant. Humphreys in 1934 reviewed 152 cases and found 37 (24.4 per cent) that had metastases. Dangremond, reviewing 42 cases in 1942 found metastases in 24 (52 per cent).

The problem of metastases is an important one for it was only 20 years ago that Forbus emphasized the benign nature of carcinoid tumors. In recent years, however their malignant tendencies have been recognized although certainly not universally. Our group

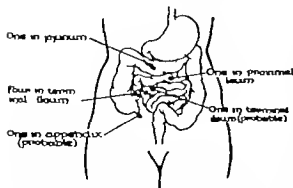


Fig 5. Five (and probably one other) of the carcinoid tumors originated in the terminal ileum. The Kulchitsky cells from which these tumors arise are common in the terminal ileum which accounts for the high incidence in this location.

cinoid tumors may be radiosensitive. It is because of these therapeutic tangles that one should be especially alert to the possibility of the presence of carcinoid tumors. With early diagnosis and adequate resection one can expect better results in the surgical treatment of these tumors than in any other intestinal malignancy.

**ABDOMEN.**—Since completion of this report, one other patient has been treated for a malignant tumor probably arising in the cecum. A white man, age 73 years, had minor episodes of generalized abdominal pain associated with diarrhea for about 1 year. Shortly before admission he noted tenderness in the right lower abdomen. He had lost 15 pounds during the year's illness. No palpable masses were noted in the abdomen but a polypoid lesion was encountered in the rectum biopsy of which demonstrated histologic evidence of malignant tumor. A filling defect in the cecum was shown by a barium enema.

Laparotomy revealed a firm mass in the cecum extending into the ascending colon. There were numerous widely scattered implants onto the peritoneum, omentum and the mesentery of both the right colon and the ileum. Nodular areas could be palpated in the liver but these were not visible on its surface. Microscopic examination of one of the implants revealed the familiar pattern of carcinoid tumor.

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their relatively slow growth one would expect carcinoid tumors to be more amenable to surgical treatment than other malignant tumors of the intestine.

Prognosis depends upon the presence or absence of irremovable metastases. However even in their presence patients may live for many years after their recognition. Stewart and Taylor's patient was alive 10 years after developing metastases, and Mallory's patient lived for 20 years. This relative longevity may be attained even in those cases in which only a shortcircuited operation is possible. Terplan, Weintraub and Wolf report the case history of a patient who survived 5 years after ileocolostomy for a carcinoid tumor with hepatic metastases. The patient died by drowning 5½ years after operation. Necropsy examination showed that there was regression of the primary tumor and the hepatic metastases had remained without further growth.

Few reports have mentioned the use of radiation in the treatment of carcinoid tumors. In Ariel's case (1939) a probable metastasis in the right iliac fossa was treated by radiation with disappearance of the tumor. Bailey has suggested that the postoperative use of radiation may improve still further the relatively good prognosis of this type of intestinal tumor. Two of our patients received radiation therapy given as a palliative measure. It is impossible to draw conclusions concerning the benefits of such therapy from the observation of these patients.

#### SUMMARY

In addition to the ordinary adenocarcinomas, superficially related tumors known as carcinoid or argentaffin tumors also appear in the gastrointestinal tract. They occur as single nodules in the appendix but are more often multiple elsewhere in the gastrointestinal tract. In the appendix they appear in young people contrasting markedly with their appearance elsewhere in patients whose average age is 58 years. This report concerns 11 such tumors arising in the appendix and 8 whose origins were in the small intestine. Those appearing in the appendix occurred as submucosal nodules extending peripheralward to involve in succession the muscularis, the

serosa and in 1 instance the mesoappendix. All were treated by simple appendectomy after which no sequelae were noted. At the opposite extreme are the 8 patients exhibiting small bowel argentaffin tumors all of which manifested malignant characteristics as shown by local or distant metastatic spread. The similarity of histologic pattern and growth tendency leads one to believe that the tumors in either location are similar if not identical and that metastases and therefore apparent malignancy are merely a matter of time. In a small narrow blind-ending tube such as the appendix attention is called to the organ early so that the tumor is still a localized one when removed by simple appendectomy. In the small bowel such early signs as are present are most often confused with abdominal conditions not requiring immediate surgical intervention. Hence intestinal tumors are not reached at such an early stage as are those in the appendix so that metastases have had time to develop.

Carcinoid tumors of the small bowel are most often seen in the terminal ileum. Their predominant spread is regional but wide spread abdominal or distant metastases may occur just as in the more common adenocarcinomas.

Attention is called to the four most common symptoms and signs noted in carcinoid tumors of the small bowel. The tetrad of intermittent episodes of small bowel obstruction associated with abdominal pain, diarrhea and weight loss is so common and indeed quite characteristic, that consideration of such tumors is strongly advised when this syndrome appears. The roentgenological study of the small intestine in an attempt to demonstrate both kinking and tumor of the bowel is an important aid in obtaining a correct and early preoperative diagnosis.

The excellent results obtained from wide excision of the tumor bearing area cannot be too strongly emphasized. Even when distant metastases have already occurred, it is not unusual to note a tendency toward stabilization of the metastatic deposits after the primary lesion has been removed. Postoperative radiation may be beneficial for there is suggestive though incomplete evidence that car

the lesion in respect to the peritoneal reflection were incidental and not the primary concern of their study. They therefore, did not exercise certain controls which we employed. These are (1) elimination of low-lying lesions which may affect prognosis unfavorably, (2) maintenance of uniformity of histologic grade and type of lesion (Dukes), and (3) comparison of lesions which were essentially at the same level in the bowel some of which were above and others below the peritoneal reflection.

#### MATERIAL AND METHODS

The material for this study was selected in such a way that all factors which might influence prognosis were controlled except the relation of the location of the lesion to the level of the peritoneal reflection.

All cases in which an adenocarcinoma of the rectum, rectosigmoid, and lower part of the sigmoid colon was removed by combined abdominoperineal resection in one or two stages, from 1916 through 1940 were selected from the files of the Mayo Clinic. From this large group, all cases in which the adenocarcinoma had been graded 2 (the Broders method, 2) by the pathologist previously examining the specimen were selected. From this group were eliminated all cases in which a metastatic lesion was demonstrable in the liver at the time of operation, those in which resection for some other reason was considered only palliative and those in which the patient died during the post-operative period of hospitalization.

In this manner, 296 cases were obtained and the formalin preserved, gross specimen removed in each of these was available for examination. Each of these gross specimens was carefully re-examined, and 137 of them were found to be suitable for inclusion in the present study. The remainder were discarded because of failure to conform to one or more of the following requisites for inclusion in this series: (1) The lesion must have been located completely above the level of the peritoneal reflection, or completely below it. Lesions lying mainly above or below this level but going over it in part were discarded. (2) The lower edge of the lesion must have been at least 2 centimeters re-

moved from the anal margin, as measured in the fixed specimen. This second requisite was adopted in order to eliminate the extremely low lying lesions whose mode of spread may differ from that of higher-lying rectal lesions and hence whose curability may differ. (3) The lesion must have been the only carcinoma in the specimen removed, multiple primary carcinomas were thus excluded. Adenomatous polyps were not considered to be carcinomas and thus their presence did not eliminate a case from inclusion in the study. (4) Enough of the gross specimen must have been present to allow adequate identification of the peritoneal reflection measurement of the distance from the lower edge of the lesion to the anal margin and selection of tissue for microscopic examination from the lesion and from the regional lymph nodes. Only a few cases were eliminated because the specimen failed to meet this last specification.

Each of the 137 gross specimens finally selected was carefully examined and a sketch was made of each. The size of the carcinoma and its situation with respect to the level of the peritoneal reflection and to the anal margin were noted. Incisions from the serosal surface or from that of the fascia propria to the mucosal surface were made transversely to the long axis of the bowel at intervals of approximately 0.5 centimeter. These thin slices hinged on the uncut mucous membrane and greatly facilitated the search for involved lymph nodes. Each specimen was carefully dissected for such nodes, and any that were suspected of being involved were removed and transferred to bottles containing a fresh 10 per cent solution of formalin. These specimens were subsequently sectioned with the freezing microtome cut at 10 microns thickness stained in the routine manner with hematoxylin and eosin, and examined microscopically for the presence of metastatic carcinoma. The primary growth was cut across through its most deeply ulcerated part, and note was made whether it had involved perirectal fat or had penetrated the serosa. Sections were then taken from the deepest extent of the growth, from all regions of apparent subserosal or serosal infiltration,

# THE ROLE OF THE PERITONEAL REFLECTION IN THE PROGNOSIS OF CARCINOMA OF THE RECTUM AND SIGMOID COLON

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**A**LTHOUGH studies on the factors affecting the prognosis of carcinoma of the rectum and lower part of the sigmoid colon are not new the present availability of a number of operative procedures for lesions in this region has stimulated increased thought and attention to these factors. Segmental resection with end-to-end anastomosis (3-15) modifications of the Hochenegg pull through procedure (1) and low segmental resection with anastomosis through the sacral or perineal approach (11-13) all have now appeared to challenge the classical combined abdominoperineal resection for carcinoma in this region. These procedures preserve function of the anal sphincter to some degree at least and do not necessitate a permanent abdominal colostomy.

An accurate appraisal of the merits of these procedures and the indications for their employment depends on several considerations. Differences in operative mortality must of course be ascertained. The adequacy of function of the sphincter when these procedures are used and the merits of such function in comparison with a colonic stoma should be known. An understanding of the factors affecting prognosis in cases of carcinoma of the rectum and lower part of the sigmoid colon is of fundamental importance in the selection of a curative operative procedure. Although there are many such factors, we are concerned here with only one of these namely the relation of the location of the growth to the level of the reflection of

the pelvic peritoneum from the wall of the bowel.

Some surgeons consider that the prognosis when lesions lie below the peritoneal reflection is inherently poorer other factors being equal than when lesions lie above this reflection in a portion of bowel covered by serosa. Thus these same surgeons tend to employ a more radical procedure usually combined abdominoperineal resection, for lesions below the peritoneal reflection although other factors might have permitted a procedure which allowed preservation of the anal sphincter.

It thus seemed of value to determine whether or not the location of the lesion with reference to the peritoneal reflection has any influence on the prognosis in cases of carcinoma low in the sigmoid colon and high in the rectum. A careful review of the literature failed to reveal a single study of this matter. Therefore the present investigation was undertaken.

Since this project was completed however the most recent of the careful studies on carcinoma of the intestine carried out by Gilchrist and David has been published. These authors found that in their cases colonic carcinoma situated partially or completely below the peritoneal reflection had a relatively high incidence of recurrence and metastasis, and thus that in their group the prognosis in such cases was poorer than in cases in which the lesions were completely above the peritoneal reflection. It might seem from this, that the location of the growth in relation to the peritoneal reflection does have an effect on prognosis.

Close study of the report of Gilchrist and David revealed however that their findings with regard to the effect of the location of

Abridgment of thesis submitted by Dr. Kirklin, fellow to Serrery Mayo Foundation, to the Faculty of the Graduate School of the University of Minnesota in partial fulfillment of the requirements for the degree of Master of Science in Surgery. From The Division of Surgical Pathology and The Division of Surgery, Mayo Clinic.

TABLE III—CARCINOMAS 5 6 OR 7 CENTIMETERS ABOVE ANAL MARGIN FIVE YEAR SURVIVAL RATES

Site of lesions	Patients studied	Patients traced	Lived 5 or more years after operation	
			Patients	Per cent of patient traced
Above the peritoneal reflection	20	6	7	43.8
Below the peritoneal reflection	4	4	6	40

At a variable level the peritoneum is reflected off the lateral surfaces of the rectum to the sides of the pelvis and from the anterior surface of the rectum to the bladder in the male and to the posterior vaginal wall in the female (12). The anterior reflection is of course higher in the male than in the female and is at a variable height from the anal margin in both.

The level of the peritoneal reflection is an arbitrary point to a certain extent. This is inevitable because of the anatomic features previously mentioned which are illustrated in Figure 1. It seemed wise in this study to consider the point of lateral reflection of the peritoneum to the pelvic wall as the level of the peritoneal reflection although in many instances the peritoneum did dip lower than this on the anterior surface of the rectum. This lateral reflection was in nearly every instance definite and its site could be identified easily. Its employment as the level of peritoneal reflection gave results which could be reproduced accurately.

In the specimens studied this level of peritoneal reflection was from 5 to 10 centimeters above the anal margin which is in good agreement with the classic description of this region (10).

#### RESULTS

Of the patients traced who had lesions above the level of the peritoneal reflection 54.4 per cent survived 5 years or more after operation and 59.4 per cent of those whose lesions were below the level survived 5 years (Table I). Both groups of patients had undergone combined abdominoperineal resection. The difference in the 5 year survival rates is

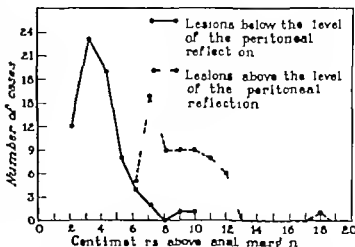


Fig. 2 Site of the lesion with reference to the anal margin in the two groups of cases studied.

probably not significant and thus the prognosis in the entire series of cases in which the lesion is located above the level of the peritoneal reflection is entirely comparable to that in cases in which it is below it.

In Table II are presented the 5 year survival rates of the groups of patients with lesions above and below the level of the peritoneal reflection broken down according to the slight modification of the Dukes method of typing previously described. It is apparent from these data that type for type the prognosis in cases in which the lesions are above the level of the reflection is entirely comparable with the prognosis when the lesions are below the reflection. This is further strong evidence to support the conclusion derived from this study that the location of the lesion with reference to the peritoneal reflection has no effect on the prognosis.

Before this conclusion was accepted it had to be established with as much certainty as possible that variation in location of the lesions in the two groups with reference to the anal margin did not influence the results. In order to establish this point the data were analyzed further.

The distance from the lower edge of the lesions to the anal margin as measured in the fixed specimens in the two groups of cases is shown in Figure 2. Because of the marked variation in the level of the peritoneal reflection from the wall of the low part of the sigmoid colon and rectum as previously mentioned there was some overlapping he-

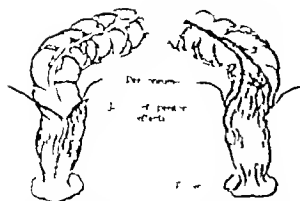


Fig. 1. The peritoneal covering of the rectum and lower part of the sigmoid colon. A growth at the location where the sigmoid colon has relatively little opportunity for direct serosal invasion, even though it lies above the level of the peritoneal reflection.

and from any region of perirectal spread. These specimens were transferred to bottles containing a fresh 10 per cent solution of formalin and were sectioned and stained as previously mentioned. These sections were then examined for confirmation of the grading according to the method of Broders and for typing according to a modification of the method of Dukes. Microscopic evidence of actual serosal penetration in contrast to mere subserosal infiltration was sought. By this review 6 cases were eliminated because of a previous error in grading them as grade 2 which left 131 cases in the final group.

The method of typing employed was a slight modification of the Dukes method (5). The criteria employed were as follows: type A lesion limited to the mucosa; type B lesion extended into the muscularis propria but did not penetrate through it; type B<sub>1</sub>

TABLE I.—COMPARISON OF FIVE YEAR SURVIVAL RATES IN CASES OF CARCINOMA SITUATED ABOVE AND BELOW THE LEVEL OF THE PERITONEAL REFLECTION

Site of lesion	Patients studied <sup>a</sup>	Patients traced	Lived 5 or more years after operation	
			Patients	Per cent of traced patients
Above the peritoneal reflection	6	57	31	54
Below the peritoneal reflection	69	64	15	23

In Nos. 1 and 2 all subsequent follow-up, largely was as of January 1, 1941. In all instances, operation was performed in 1936 or earlier.

lesion penetrated through the muscularis propria and type C lesion of either type B<sub>1</sub> or B<sub>2</sub> with involvement of lymph nodes.

The clinical history and the follow-up correspondence in all cases were reviewed. The cases were separated into two groups, one in which the lesions were located above the level of the peritoneal reflection and the other in which the lesions were located below this level. The data thus obtained were compared.

#### ANATOMIC CONSIDERATIONS

The sigmoid colon is covered by peritoneum except for the narrow mesenteric attachment low in the sigmoid colon. This mesenteric attachment gradually becomes broader and in the region of the sigmoid-rectal junction may occupy nearly half the circumference of the intestinal wall. Because of this, the upper portion of the rectum is devoid of peritoneal covering on its posterior surface while the lateral and anterior surfaces are covered with peritoneum (4 to 12).

TABLE II.—COMPARISON OF FIVE YEAR SURVIVAL RATES IN CASES OF CARCINOMA SITUATED ABOVE AND BELOW THE PERITONEAL REFLECTION ACCORDING TO TYPE (DUKES) OF LESION

Type	Lesions above the level of the peritoneal reflection				Lesions below the level of the peritoneal reflection			
	Patients studied	Patients traced	Lived 5 or more yr. P. O.		Patients studied	Patients traced	Lived 5 or more yr. P. O.	
			Patients	Per cent of traced patients			Patients	Per cent of traced patients
A								none
B <sub>1</sub>	3		3	75	6	3	3	50
B <sub>2</sub>		20		70	36	33	3	69
C	34	3		26.4	4	1	0	0

TABLE III—CARCINOMAS 5 OR 6 OR 7 CENTIMETERS ABOVE ANAL MARGIN FIVE YEAR SURVIVAL RATES

Site of lesions	Patients studied	Patients traced	Lived 5 or more years after operation	
			Patients	Percent of patient traced
Above the peritoneal reflection	20	6	7	43.8
Below the peritoneal reflection	4	4	6	4.0

At a variable level the peritoneum is reflected off the lateral surfaces of the rectum to the sides of the pelvis and from the anterior surface of the rectum to the bladder in the male and to the posterior vaginal wall in the female (12). The anterior reflection is of course higher in the male than in the female and is at a variable height from the anal margin in both.

The level of the peritoneal reflection is an arbitrary point to a certain extent. This is inevitable because of the anatomic features previously mentioned which are illustrated in Figure 1. It seemed wise in this study to consider the point of lateral reflection of the peritoneum to the pelvic wall as the level of the peritoneal reflection although in many instances the peritoneum did dip lower than this on the anterior surface of the rectum. This lateral reflection was in nearly every instance definite and its site could be identified easily. Its employment as the level of peritoneal reflection gave results which could be reproduced accurately.

In the specimens studied this level of peritoneal reflection was from 5 to 10 centimeters above the anal margin which is in good agreement with the classic description of this region (10).

#### RESULTS

Of the patients traced who had lesions above the level of the peritoneal reflection 54.4 per cent survived 5 years or more after operation and 59.4 per cent of those whose lesions were below the level survived 5 years (Table I). Both groups of patients had undergone combined abdominoperineal resection. The difference in the 5 year survival rates is

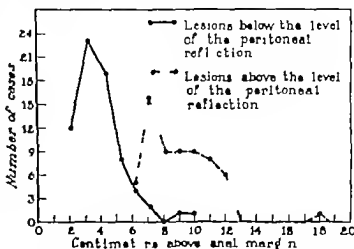


Fig. 2 Site of the lesion with reference to the anal margin in the two groups of cases studied

probably not significant, and thus the prognosis in the entire series of cases in which the lesion is located above the level of the peritoneal reflection is entirely comparable to that in cases in which it is below it.

In Table II are presented the 5 year survival rates of the groups of patients with lesions above and below the level of the peritoneal reflection broken down according to the slight modification of the Dukes method of typing previously described. It is apparent from these data that type for type the prognosis in cases in which the lesions are above the level of the reflection is entirely comparable with the prognosis when the lesions are below the reflection. This is further strong evidence to support the conclusion derived from this study that the location of the lesion with reference to the peritoneal reflection has no effect on the prognosis.

Before this conclusion was accepted it had to be established with as much certainty as possible that variation in location of the lesions in the two groups with reference to the anal margin did not influence the results. In order to establish this point the data were analyzed further.

The distance from the lower edge of the lesions to the anal margin as measured in the fixed specimens in the two groups of cases is shown in Figure 2. Because of the marked variation in the level of the peritoneal reflection from the wall of the low part of the sigmoid colon and rectum as previously mentioned there was some overlapping be-

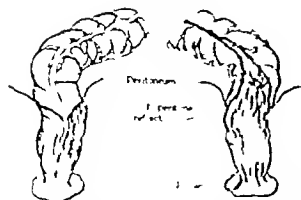


Fig. The peritoneal covering of the rectum and lower part of the sigmoid colon. A growth of the sigmoid colon has relatively little opportunity for direct serosal invasion, even though it lies above the level of the peritoneal reflection.

and from any region of perirectal spread. These specimens were transferred to bottles containing a fresh 10 per cent solution of formalin and were sectioned and stained as previously mentioned. These sections were then examined for confirmation of the grading according to the method of Broders and for typing according to a modification of the method of Dukes. Microscopic evidence of actual serosal penetration in contrast to mere subserosal infiltration was sought. By this review 6 cases were eliminated because of a previous error in grading them as grade 2 which left 131 cases in the final group.

The method of typing employed was a slight modification of the Dukes method (5). The criteria employed were as follows: type A lesion limited to the mucosa; type B<sub>1</sub> lesion extended into the muscularis propria but did not penetrate through it; type B<sub>2</sub>

TABLE I—COMPARISON OF FIVE YEAR SURVIVAL RATES IN CASES OF CARCINOMA SITUATED ABOVE AND BELOW THE LEVEL OF THE PERITONEAL REFLECTION

Site of lesion	Patients studied	Patients traced	Lived 5 or more years after operation	
			Patients	Per cent of total patients
Above the peritoneal reflection	8	37	3	8
Below the peritoneal reflection	49	84	7	8

\*1. This and all subsequent tables, largely was as of January 1, 1948. In all instances, operation was performed in 1948 or earlier.

lesion penetrated through the muscularis propria and type C lesion of either type B<sub>4</sub> or B<sub>5</sub> with involvement of lymph nodes.

The clinical history and the follow up correspondence in all cases were reviewed. The cases were separated into two groups, one in which the lesions were located above the level of the peritoneal reflection and the other in which the lesions were located below this level. The data thus obtained were compared.

#### ANATOMIC CONSIDERATIONS

The sigmoid colon is covered by peritoneum except for the narrow mesentery at attachment low in the sigmoid colon. This mesenteric attachment gradually becomes broader and in the region of the sigmoid-rectal junction may occupy nearly half the circumference of the intestinal wall. Because of this, the upper portion of the rectum is devoid of peritoneal covering on its posterior surface while the lateral and anterior surfaces are covered with peritoneum (4, 10, 12).

TABLE II—COMPARISON OF FIVE YEAR SURVIVAL RATES IN CASES OF CARCINOMA SITUATED ABOVE AND BELOW THE PERITONEAL REFLECTION ACCORDING TO TYPE (DUKES) OF LESION

Type	Lesions above the level of the peritoneal reflection				Lesions below the level of the peritoneal reflection			
	Patients studied	Patients traced	Lived 5 or more yr. P. O.		Patients studied	Patients traced	Lived 5 or more yr. P. O.	
			Patients	Per cent of traced patients			Patients	Per cent of traced patients
A								100
B <sub>1</sub>	5		5	100	3	3	6	100
B <sub>2</sub>		20	20	100	36	33	3	9.1
C	24	7	26.4	110	4	3	3	100





tween the two groups at certain levels. Thus some of the lesions situated 5, 6 and 7 centimeters above the anal margin were completely above the peritoneal reflection and others were completely below it. Due to this fortunate occurrence it was possible in a small group of cases in which the lesions were at essentially the same level in the rectum to compare the prognosis when the lesions were located above the reflection with that in cases in which they were located beneath it. As shown in Table III such a comparison indicated that there was no significant difference in the 5 year survival rate in the two groups. This observation substantiates the conclusion that the location of the lesion with respect to the level of the peritoneal reflection does not affect prognosis following radical combined abdominoperineal resection for carcinoma of the rectum and lower part of the sigmoid colon.

It should be noted that there is no justification for drawing conclusions as to the significance of the relatively low survival rate in cases in which lesions were 5, 6 and 7 centimeters from the anal margin. The method employed in selecting the cases for this study controlled factors pertinent to this analysis but did not control factors pertinent to a study of the effect of the level of the lesion on prognosis. An investigation of this effect is being made at present.

#### COMMENT

The present difference of opinion as to the surgical procedures of choice in dealing with carcinoma of the lower part of the sigmoid colon and rectum makes necessary the accumulation of all possible pertinent data. It is, of course, true that when each procedure has been carried out a significant number of times in comparable cases, and the patients have been followed for a period long enough to insure reliable survival rates, a comparison of these rates will give a reasonable insight into the relative efficacy of these procedures.

However the difficulties inherent in the comparison of statistical material obtained from different sources in the literature are well known. Operability rates, operative mortality rates and types of lesions as well

as the location of lesions all influence the over all 5 year survival rate and all are rarely given in the reports. Furthermore unless the series are actually comparable in all respects and all factors which may produce variation in prognosis in and of themselves are controlled comparison of different statistical analyses is valueless. For example the comparison of the 5 year survival rates after anterior resection with those after combined abdominoperineal resection is valid only if the groups of cases in which these two procedures have been employed are entirely comparable. Obviously to begin with, the investigator must be certain that the 5 year survival rate in cases in which the lesions are high in the rectum or low in the sigmoid colon (that is lesions suitable for anterior resection) and are removed by combined abdominoperineal resection is entirely comparable to that for the entire group treated by abdominoperineal resection. If the survival rate in cases of high-lying lesions is better after combined abdominoperineal resection than is the survival rate in cases of low lesions after the same procedure then the 5 year survival rate following anterior resection must be compared not to that for the total group of patients treated by combined abdominoperineal resection but to that of the patients who had lesions at the same level as those treated by anterior resection.

Thus, in order to compare statistical data obtained from the various operative procedures with regard to survival rates alone the data must be as complete as possible on the factors affecting the prognosis. Furthermore when these factors in prognosis are recognized and the manner of growth and spread of such lesions are understood the surgeon can feel more secure in adopting a particular method of surgical management without awaiting the accumulation of data in sufficient quantity to give survival rates of undoubted significance.

It has been clearly demonstrated (14) that the microscopic appearance of the carcinomatous cells reflected in the Broders system of grading is one factor which must be considered and controlled in comparing statistical results. The choice of a surgical pro-

cedure in a given case is rarely influenced by this factor however. The type of the lesions according to the Dukes method of typing is of prognostic significance (6) and must be controlled in comparisons of statistical data again this is rarely known pre-operatively and thus unfortunately is of little value to the surgeon in choosing an operative method in a given case (9). It is probable that the location of lesions in the rectum and lower part of the sigmoid colon with reference to their distance from the anal margin exerts an influence on prognosis. It is then one further factor which must be controlled in comparisons of statistical data and which must be taken into account in the choice of the surgical procedure to be employed in a given case. The method of lymphatic spread is of utmost importance in the choice of an operative procedure (8) but since it is relatively constant for lesions in the same location it is not a factor that need be controlled in comparisons of statistical data provided the previously discussed factor of location is controlled.

Since some lesions of the rectum and lower part of the sigmoid colon lie above the level of the peritoneal reflection and some lie below this level the relation of the lesion to the peritoneal reflection is a further factor

which should be understood with reference to prognosis and with reference to the selection of a curative operative procedure. It is demonstrated in this study that the location of the lesion with reference to the level of this peritoneal reflection has no effect on prognosis.

Thus in comparisons of statistical material and in the selection of an operative procedure in a given case this factor may be ignored.

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# CARCINOMA OF THE ENDOMETRIUM IN YOUNG WOMEN

HAROLD SPIERT, M.D., New York, New York

**N**O woman regardless of age is immune to uterine cancer. Carcinoma of the cervix although rare in young girls is fairly common in women of 40 or younger. At the Roosevelt Hospital 27 per cent of all patients with cancer of the cervix were under 41 years of age. Cancer of the corpus on the other hand is regarded as extraordinary in women of this age group. Donald and Shaw (1929) have expressed the opinion that with the rarest exceptions cancer of the body of the uterus does not begin in subjects under 40 years of age or alternatively until after the retrogressive changes of the menopause have set in. Present experience however suggests that even fundal neoplasms in young women may be not so rare as is generally believed. The literature contains numerous references to individual cases of cancer of the corpus in children (Hirst 1929, Kehrer and Neumann 1929, Gilbert 1932, Lockhart 1935), young girls (Smith 1933, Mazzola 1938, Healy and Brown 1939, Morrin and Max 1939) and women in their early thirties (Purdie 1945, Bianchi 1946, Taylor and Stecker 1947, Driesen 1947). In a recent tabulation of 255 cases of primary carcinoma of the endometrium 12 patients (4.6 per cent) were under age 41 (Spiert 1948). Two additional cases of cancer of the corpus in young women which have come to light since then make our incidence of women with this disease in the first 4 decades of life about 5 per cent. These 14 cases form the basis of the present report.

Some of the salient clinical and pathological features of the cases are summarized in Table I. From their study emerges evidence in support of the theory that continuous and unopposed estrogenic stimulation is a factor in the pathogenesis of endometrial carcinoma.

**Fertility.** The group as a whole showed a remarkably low degree of fertility. Eight of the patients (57 per cent) had never borne children. This percentage is slightly higher

than the incidence of nulliparas among all our patients with endometrial carcinoma (41 per cent). The average parity of the 14 patients was only 0.57. In comparison to 1.34 for all patients with cancer of the corpus and 2.83 for those with cancer of the cervix. It is a striking fact that although all 14 patients were of child bearing age, the most recent pregnancy among them had occurred 14 years previously.

**Ovaries.** Description of the ovaries is based on restudy of the histologic sections when available. In the other cases on the recorded pathological reports. In 8 cases the ovaries were described as cystic, in 1 as sclerotic, and in 1 as hyaline. Routine sections of the majority of the ovaries contained no evidence of ovulation. In only 2 cases were recent corpora lutea seen. Counseller (1938) has also been impressed with this negative correlation, stating that he had never seen a carcinoma of the fundus in which there was not also a failure or inactivity of the corpus luteum. An interesting feature present in several of the present cases was an unusually thick tough, fibrous tunica albuginea (Figs. 2 and 5). This may possibly have acted as a mechanical barrier to ovulation as suggested by Babes (1924) and others. Theca cell hyperplasia was described in 1 case. Two patients had had an ovary removed previously because of benign cysts.

**Endometrium.** The uninvolved parts of the endometrium reflected the absence of luteal activity. In no instance was a secretory type of endometrium encountered. This differs sharply from the experience of Jones and Brewer (1941) who described a secretory endometrium in 8 of 19 premenopausal patients with fundal carcinomas. On the contrary endometrial hyperplasia was present in at least 5 of our patients. In 1 instance (Case 3) hyperplasia was probably of long standing since it had also been diagnosed by curettage 6 years before. Another patient (A. C. Table I) had had treatment with intrauterine radium 16 years previously because of functional bleeding which

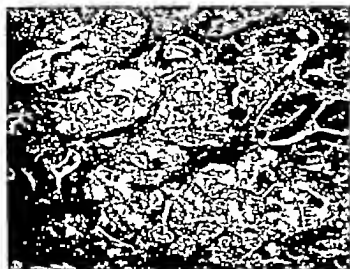


Fig. 1 Case 1 Adenocarcinoma in hyperplastic endometrium of patient aged 33 years.

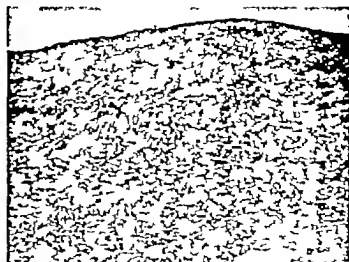


Fig. 2 Case 1 Section of ovary showing thick, fibrous tunica albuginea.

was associated with endometrial hyperplasia.

**Cervix** Squamous metaplasia resulting in epidermidization of the endocervical glands was seen in routine sections of 5 of the removed cervixes. Since 2 cervixes were not described, 1 was not removed, 1 was invaded by the endometrial tumor, and 1 showed a radiation reaction, the incidence of cervical epidermidization in the 9 remaining cases was 56 per cent. The possible significance of this lesion as a manifestation of abnormal estrogenic stimulation has been discussed in another paper (Speert 1948).

Three cases reported herewith in detail exemplify the combination in young women of endometrial hyperplasia, endometrial carcinoma, cystic ovaries with thick tunics and no corpora lutea, and epidermidization of the cervix.

**CASE 1** F. W., a 33 year old colored nulliparous divorcee, was admitted to the hospital on February 6, 1947, for curettage because of menorrhagia. Her menses had always been irregular, long periods of amenorrhea up to a year alternating with periods of bleeding lasting a week to a month. Her last flow occurred in mid-December 1946; the current flow began January 16, 1947. Examination was negative. Basal metabolic rate was  $-16$ . Uterine curetting showed endometrial hyperplasia and adenocarcinoma, grade 1 (Fig. 1). On February 11, total hysterectomy and bilateral salpingo-oophorectomy were performed. The ovaries were large, white, and smooth, and each was encased in a tough, thick tunica albuginea (Fig. 2). Immediately subjacent to this capsule were numerous small follicular cysts. There was no histologic evidence that either ovary had ever

ovulated. Section of the cervix showed epidermidization of the glands (Fig. 3).

This is an excellent example of polyhormonal amenorrhea (Zondek 1934) alternating with periods of menorrhagia. The associated hyperplasia of the endometrium, a presumably long-standing response to continuous unopposed estrogenic stimulation, was the apparent forerunner of a grade 1 adenocarcinoma.

**CASE 2** M. H., a 22 year old white single patient of Dr. William P. Healy, had suffered for several years with irregular intermenstrual bleeding. Various types of endocrine therapy had failed to control this bleeding. Curettage on June 13, 1944, produced a profusion of tissue which was diagnosed as hyperplasia. The patient's periods became regular for 8 months. Intermenstrual bleeding then returned, occurring daily for about 3 months prior to her readmission on January 8, 1947. Another curettage again brought forth voluminous scrapings. Diagnosis this time was endometrial hyperplasia and adenocarcinoma, grade 1. When the section of the original curettings was now reviewed, a similar type of car-



Fig. 3 Case 1 Epidermidization of cervical glands.

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From the Gynecological Service of the Roosevelt Hospital.



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Fig 3 Case 1 Epidermidization of cervical glands.



Fig. 4. Case 1. Adenocarcinoma in hyperplastic endometrium of patient aged 35 years.

omatous change was discovered. The gross and microscopic findings in the endometrium (Fig. 4), ovaries (Fig. 5), and cervix (Fig. 6) of this patient were similar to those in Case 1.

This case illustrates the importance of investigating by curettage abnormal bleeding



Fig. 5. Case 1. Section of ovary showing tunica albuginea.



Fig. 6. Case 1. Microscopic section also showed epidermalization of cervical glands.

even in young women before resorting to hormonal therapy. Scheffey, Farrell and Hahn (1945) have reported 7 cases in which uterine cancer was overlooked because estrogens were used for irregular bleeding without preliminary curettage. Our recent records include several additional cases in which the same error was committed.

**CASE 3.** C. M., a tremendously obese (360 pounds) 37 year old white woman with a child of 14 years, was admitted February 10, 1947 because of menorrhagia. For 9 years her periods had lasted 10 to 14 days and for the past 6 weeks an irregular flow was observed every 2 to 4 days. Curettage had been performed 6 years previously for the same type of complaint with the curettings showing atypical hyperplasia. Curettage was repeated on February 12, 1947. Pathological report on the scrapings: "endometrial hyperplasia with early carcinoma." The uterus and adnexa were removed a week later. The ovaries were cystically enlarged to a maximum diameter of 7 centimeters. Their tunics were smooth, tough, and fibrous, and measured up to 4 millimeters in thickness. There was no anatomical evidence of recent ovulation. Section of the endocervix also showed epidermalization of the glands.

This case is a further example of carcinoma arising in a pre-existing hyperplastic endometrium. The interval of almost 6 years between the 2 curettings indicates the slowness of the malignant transformation. In another case (A. C. Table I) a patient of 37 1/2 years had elapsed between the original diagnosis of hyperplasia and the subsequent detection of adenocarcinoma. Mazzola (1938) has also re-

TABLE I.—CARCINOMA OF ENDOMETRIUM IN PATIENTS AGED 40 AND UNDER

Patient	Race	Age	Parity	Last pregnancy	Ovaries	Cervix	Remarks
C. M.	W	37		4 years	Cystic, no C.L.	Epidermidization	Endometrial hyperplasia for 6 years
F. W.	C	33			Cystic, no C. L.	Epidermidization	Endometrial hyperplasia
M. N.	W				Cystic, no C.L. thick cell hyperplasia	Epidermidization	Endometrial hyperplasia + basal endometriosis
A. C.	W	37			Cystic, no C.L.	Epidermidization	Hyperplasia previously
M. C.	W	36		4 years	Cystic, corpus albicans	Reported normal	Ovarian cystectomy yrs
A. R.	W	4			Not removed	Radiation reaction	Preoperative irradiation
G. C.	C	31			Cystic, no C.L.	Not described	
M. C.	W	30		8 years	Cystic, corpus albicans	Reported normal	Rectal cancer 6 yrs. lat
E. H.	W	40			Recent C. L.	Normal	
R. F.	W	40		8 years	Cystic, corpus luteum	Not removed	Endometrial hyperplasia
A. G.	W	38		6 years	Tumor		
A. A.	W	36		7 years	"Sclerotic"	Reported normal	Endometrial hyperplasia
C. V.	W	30			"Hyaline," no C.L.	Epidermidization	
E. B.	W	31			Tumor	Not described	Ovarian cystectomy now

C. L., corpus lutea

ported a case of endometrial carcinoma in a young girl 12 years after the first of several curettages and radium applications for recurrent hyperplasia

#### DISCUSSION

This paper is designed to emphasize three main points. First carcinoma of the endometrium although typically a disease of middle age is not as rare in young women as is generally believed. Approximately 5 per cent of all cases of cancer of the corpus at the Roosevelt Hospital have been in women not over 40 years old. The second point is a corollary to the first. Abnormal uterine bleeding not associated with pregnancy merits curettage in addition to any other type of investigation regardless of the patient's age. Not only will an occasional unsuspected uterine carcinoma be discovered in young women in this manner but curettage alone affords temporary or permanent cure in many cases of functional bleeding. Hormonal therapy without preliminary curettage is unsound. Finally the cases which form the basis of this report suggest that women who develop endometrial cancer within the first 4 decades of life conform in general to a specific hormonal pattern characterized by long continued and unopposed estrogenic activity. This is indicated by their low fertility and the

high incidence among them of endometrial hyperplasia, cystic ovaries with no evidence of recent ovulation and epidermidization of the cervical glands.

A recent study by Novak and Rutledge (1948) has called attention to certain atypical benign lesions of the endometrium sometimes encountered in young women which may simulate adenocarcinoma. In the light of their work one might naturally ask whether the cases herein reported were instances of genuine cancer. Only 1 of our patients is known to have died of the disease. In another metastatic tumor was present in the ovaries. In the remaining dozen cases the diagnosis rested on the opinion of the pathologist corroborated in a few instances by consultation with another pathologist. Recent restudy of the sections has substantiated the original diagnosis in each instance.

#### SUMMARY

1. Fourteen cases of endometrial carcinoma in women 40 years of age or under are reported. About 5 per cent of all corpus cancers at the Roosevelt Hospital were in this age group.

2. These cases were characterized by a high incidence of infertility, hyperplasia of the endometrium, cystic ovaries without recent ovulation and epidermidization of the cervical glands.





Fig. 4. Case 1. Adenocarcinoma in hyperplastic endometrium of patient aged 35 years.

cinomatous change was discovered. The gross and microscopic findings in the endometrium (Fig. 4) ovaries (Fig. 5) and cervix (Fig. 6) of this patient were similar to those in Case 2.

This case illustrates the importance of investigating by curettage abnormal bleeding

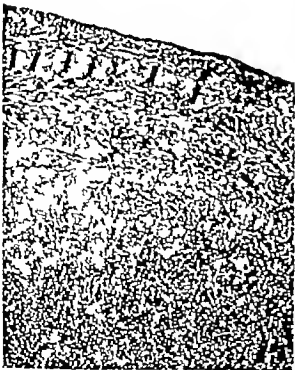


Fig. 5. Case 1. Section of ovary showing tunica albuginea.

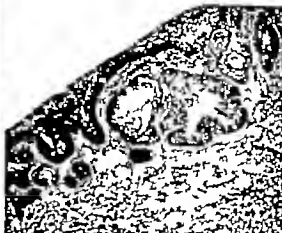


Fig. 6. Case 2. Microscopic section also showed epidermidization of cervical glands.

even in young women before resorting to hormonal therapy. Scheffey, Farrell and Hahn (1945) have reported 7 cases in which uterine cancer was overlooked because estrogens were used for irregular bleeding without preliminary curettage. Our recent records include several additional cases in which the same error was committed.

**CASE 3.** C. M., a tremendously obese (260 pounds) 37 year old white woman with a child of 14 years, was admitted February 10, 1947 because of menometrorrhagia. For 2 years her periods had lasted 1 to 14 days and for the past 6 weeks an irregular flow was observed every 1 to 4 days. Curettage had been performed 6 years previously for the same type of complaint with the curettings showing atypical hyperplasia. Curettage was repeated on February 12, 1947. Pathological report on the scrapings was endometrial hyperplasia with early carcinoma. The uterus and adnexa were removed a week later. The ovaries were cystically enlarged to a maximum diameter of 7 cm. Their tunics were smooth, tough, and fibrous, and measured up to 4 millimeters in thickness. There was no anatomical evidence of recent ovulation. Section of the endocervix showed epidermidization of the glands.

This case is a further example of carcinomatous change in a pre-existing hyperplastic endometrium. The interval of almost 6 years between the 2 curettings indicates the slowness of the malignant transformation. In another case (A. C. Table I) a patient of 37 1/2 years had elapsed between the original diagnosis of hyperplasia and the subsequent detection of adenocarcinoma. Mazzola (1938) has also re-

# EVALUATION OF THE VARIOUS CLINICAL SIGNS OF THROMBOPHLEBITIS AND EXPERIENCE IN THERAPY WITH ANTICOAGULANTS

DAVITT A. FELDER, M D., Minneapolis Minnesota

ALL patients with thrombophlebitis of the lower extremities in the University of Minnesota Hospitals from May, 1945 to January 1948 have been personally examined and followed by the author. These 92 cases represent 105 extremities with deep thrombophlebitis and in some instances with superficial thrombophlebitis as well. The majority of these patients were treated with anticoagulants. We believe that the bland and the inflammatory venous thromboses of the lower extremities may practically all be called thrombophlebitis. In our hospital for the period of our study the incidence of thrombophlebitis was 92 cases in a total of 14,116 or 0.65 per cent.

## DIAGNOSIS

This study is in part an attempt to evaluate the usual diagnostic signs and symptoms of thrombophlebitis of the lower extremities. In order to be reasonably sure of the diagnosis of thrombophlebitis we have included in this report only those cases in which at least three of the following signs and symptoms were present: swelling, vessel tenderness, pain, increased temperature in the limb, dilated superficial veins (unilateral), cyanosis (unilateral), pulmonary embolism (reasonably proved) and change in temperature and pulse (otherwise unexplained). Those cases in which unilateral swelling alone was found or pulmonary embolism alone without leg symptoms were followed but not included in this series. In 3 instances, patients with pulmonary embolism alone developed symptoms of thrombosis in 4 to 5 days and so were included in the study.

Swelling was the most frequent symptom in this series. It occurred in 93 or 88.5 per cent of the extremities. It was accompanied by tenderness in 60 extremities and by heat in only 42 instances. Swelling, heat and tender-

ness occurred in 35 extremities. In most instances, swelling was quite apparent but in some cases could be determined only by measurement. Swelling of the genitalia usually occurs when there is involvement of the common iliac vessels occluding the hypogastric vein or higher. There were 6 instances of swelling of the genitalia. In 3 instances involvement of the iliac vessels was proved at postmortem examination.

Tenderness was the symptom next in frequency to swelling. It occurred in 79 or 75 per cent of the extremities.

Deep calf tenderness is elicited by pressing between the gastrocnemius muscle bellies in the calf (Fig. 1). It was found to be the most frequent and consistent of deep vessel signs being present in 70 or 66.5 per cent of the extremities examined.

Calf squeeze tenderness is elicited by gently squeezing the calf from side to side (Fig. 2). Its value has been stressed by Moses. While probably not as significant as deep calf tenderness it is an important maneuver in substantiating deep vein involvement when used with the deep calf pressure. It was found in 56 or 53 per cent of the extremities. Calf squeeze and deep calf tenderness together occurred in 50 or 45.5 per cent of the extremities.

Homans' sign is the presence of pain in the calf elicited by passive dorsiflexion of the foot (Fig. 3). In all of these maneuvers for deep vein tenderness one must remember to keep the knee flexed thereby relaxing the calf muscles. This sign was found to be positive in 52 or 49.5 per cent of the extremities. Aside from the fact that this sign is the least frequent of those mentioned here we believe that it is much less reliable for routine examination because of the great possibility of its being positive in the presence of simple muscle involvement alone. It involves mostly muscle stretch

From the Department of Surgery, University of Minnesota.

3 Continuous unopposed estrogenic stimulation is an important factor in the pathogenesis of endometrial carcinoma.

4 Persistent abnormal uterine bleeding deserves curettage regardless of the patient's age.

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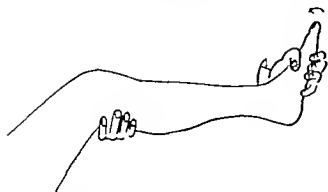


Fig. 3. Homans' maneuver of passive dorsiflexion of the foot to elicit calf pain.

**Dilated superficial veins** The presence of dilated superficial veins is sometimes of use in making a diagnosis of deep vein thrombosis. This finding was noted in only 3 cases in this series. It probably is indicative of thrombosis above the common femoral when the long saphenous bears a great burden of the venous drainage or when its entrance into the femoral is also occluded so that the pressure in it is elevated. This dilatation disappears as soon as ample additional collaterals are established with bed rest in the Trendelenburg position and with the administration of anticoagulants this ordinarily has taken no longer than 48 hours. From our experience with patients studied prior to this series and subsequent to it, we believe that dilatation of the superficial vessels occurs at least twice as often as recorded here.

**Level of thrombosis** It has been claimed by Birger and Bauer (5) that if one could stop a thrombosis from progressing above the popliteal level patients could be assured of a much brighter future as far as complicating factors such as persistent edema and stasis changes are concerned. An attempt was made to determine the level of thrombosis clinically. When a patient was found to have ankle or leg edema, it was thought, unless there was indicative tenderness higher that the patient's level of thrombosis was probably the posterior tibial vein. The thrombus might extend into the popliteal vein or higher but was probably not occluding its lumen. There were 58 such extremities the left leg being more often involved than the right.

**Sural vein thrombosis** The sural veins drain the posterior muscle group of the leg (Fig. 4)

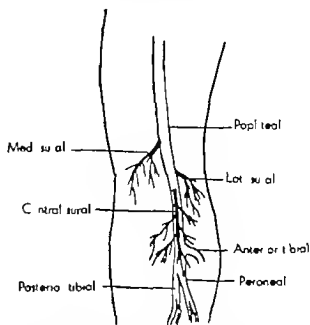


Fig. 4. Example of sural vein distribution (from dissections on amputated extremities by the author)

In 2 cases a simple sural vein thrombosis was found with surrounding induration of the calf. These thrombi can often be felt on one or both sides of the upper calf just below the knee. Sural vein thrombosis should not be treated lightly and is as important as any other deep thrombophlebitis or thrombosis for such thromboses generally progress to involve the popliteal vein and upward. Many of our patients with deep thrombosis had induration of the calf probably due to a blocking of the sural veins as they enter the popliteal.

There were 41 instances in which swelling of the thigh and legs usually with femoral vein tenderness up to the inguinal fold, was considered as an indication of iliofemoral thrombosis with the thrombosis either at a femoral or external iliac level.

In the patients with swelling and tenderness above the inguinal fold into the lower abdomen and in some cases involving the genitalia (swelling) the level of the thrombus was assumed to be iliac. With swelling of the genitalia, the level was assumed to be at the common iliac with involvement or occlusion of the hypogastric.

That clinical impressions can be grossly in correct in this disease was proved by 2 patients in whom clinically the level of the thrombosis was found to be at the posterior tibial and femoral veins respectively. At op-

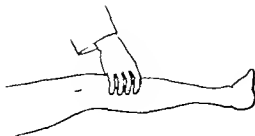


Fig. 1. Maneuver to elicit deep calf tenderness.



Fig. Calf-squeeze maneuver

ing and deep vein pressure only secondarily whereas the calf squeeze and especially the deep calf maneuvers involve more direct pressure over the vessels in question (mainly the posterior tibial and calf veins where most thromboses probably begin)

Popliteal tenderness was found in only 17 instances, never without other tenderness. This would lead one to believe that it is of limited value as a diagnostic sign.

Anterior tibial tenderness was found in only 2 instances. Involvement of the anterior tibial veins in thrombosis is not frequent but has been found to be present in a number of instances. This was indicated by fairly definite venographic studies done by the author in patients with chronic deep thrombophlebitis and in a few of the cases in this series. The infrequency of anterior tibial vein involvement might be due to the fact that these vessels do not drain large venous lakes as do the posterior tibials from the calf muscle group. Frykholm has proposed that collapse of veins with contiguity of vein walls is a causative factor in thrombosis of the deep leg veins in bedridden patients. The anterior tibial vessels are protected from such pressure by their anatomical position.

In 3 cases the tenderness shifted from the calf to appear in the femoral canal area without involving the intervening popliteal area. These cases may represent the syndrome described by Homans in which a thrombus originating in the leg later attaches in the femoral region or higher and unless the vein wall between the two areas is involved with the thrombus there is no tenderness.

Profunda femoris involvement, frequently overlooked has been emphasized by Homans. It is elicited by grasping the biceps femoris

muscles and squeezing moderately. In none of the 12 patients of our series with profunda femoris tenderness was its presence the only sign of tenderness in the extremity. Though it is possible that such a thrombosis might exist alone, our observations to date indicate that its presence alone is rare.

**Heat.** We have found that a temperature difference of 3 to 4 degrees F. can be determined fairly consistently by simple palpation. Except for a few instances, in which an electrothermocouple was used, increased heat was determined by palpation and only definite temperature differences are included.

In 54 instances, or 53 per cent, there was an appreciable temperature increase in the affected limb. Increased heat was usually accompanied by tenderness (42 extremities) and swelling (42 extremities). However there were many instances of swelling without heat (38 extremities). This latter figure includes the acute phlegmasias in which the limb was actually colder. Even with these cases excluded the incidence of swelling of an extremity without heat is still fairly high (27 instances).

**Pain.** This symptom was present in 54 patients at rest. Many more had pain in the calf only on walking. A few described their discomfort on walking as tightness rather than pain. This symptom was noted especially in patients in whom the level of the thrombosis was high, as in the iliofemoral thromboses. These patients complained of tightness in the thigh as well as in the calf.

**Color changes.** The dusky color often described as a concomitant of thrombophlebitis was noted in only 4 of our cases. There were 5 extremities which were definitely redder than their mates. One of these was the case of suppurative phlebitis. In the 11 patients with phlegmasia alba dolens discussed later the limbs were pale.

scases required 60 to 70 milligrams of heparin intravenously to maintain her  $1\frac{1}{2}$  hour clotting time at 2 to 3 times normal. The answer to this problem is not clear to us and can be theorized on at length.

The reports of the Swedish investigators, Crafoord and Jorpes (8) attracted our attention sufficiently so that we tried their dosage of 100 milligrams repeatedly during the day and 100 milligrams at midnight. Most of these cases fell into our prophylactic group (not included in this paper), but 1 patient with thrombophlebitis was so treated. It was found in this group that the clotting time at 2 hours was still between 2 and 3 times the normal and tapered down from this point instead of the  $1\frac{1}{2}$  hour peak of the 3 hour dosage of 50 milligrams.

A later work of Bauer (6) recommended a dosage of 50 milligrams every 4 hours during the day and 100 milligrams at midnight. Such obviously good results were obtained in his series that we decided to use this method of treatment with heparin and up to the end of this series of cases had tried this regimen in 25 cases. In this group the peak of the clotting time was usually at  $1\frac{1}{2}$  hours and normal again at 4 hours.

Clotting times were taken before starting heparin then in the early cases every half hour after each dose for 2 to 3 doses. It became apparent quite early that the clotting time was down to normal within from 3 to 4 hours after each injection of 50 milligrams and well within 8 hours after the 100 milligram midnight dose. This midnight dose of 100 milligrams was used merely because we wished to give Bauer's method a fair trial. It is doubtful that this 100 milligram dose adds much to the treatment. In only 1 case in our group was the clotting time elevated 8 hours after the midnight 100 milligram dose.

For the extremely ill patient with possible liver damage one might assume from our experiences with the 3 hour dosage that it would be dangerous to give such patients 50 milligrams. In these patients the 50 milligram dose produces an unpredictable clotting time peak but as shown by our studies with the 50 milligrams every 4 hours the clotting time is invariably down to normal within 3 to 4 hours.

In none of the heparin treated patients was there any serious hemorrhage. This series is hardly large enough to have a final impression on but the results are encouraging to date.

It is quite apparent that the intermittent intravenous route of giving heparin is far from ideal although empirically of value. Loewe and his co-workers perhaps have the beginning at least of a more rational and practical method of treatment with heparin in their heparin in Pitkin's menstruum (16).

We have tried this method in 7 of our patients. In 5 cases the originally recommended dose was 300 milligrams (with vasoconstrictor). In 4 of these an adequate rise in clotting time was obtained within 12 hours and it remained elevated for 12 hours. Two of these patients required supplementary intravenous heparin every 3 hours to maintain a  $1\frac{1}{2}$  hour clotting time of 2 to 3 times normal until the effect of the heparin in Pitkin's menstruum became manifest.

Two patients in this group were treated with 500 milligram doses (300 mgm. with vasoconstrictor and 200 mgm. without vasoconstrictor mixed 150 mgm. plus 100 mgm. respectively in 2 portions and injected 1 into each thigh). In these cases a good response was observed within 8 hours and the clotting times remained elevated at 2 to 3 times normal for 48 hours.

Heparin is a relatively safe anticoagulant when given intravenously by intermittent doses. Although it probably detracts from the safety element somewhat, the subcutaneous route seems to be more practical. The recent studies of McCleery and Sirak with coronamid in heparin in Pitkin's menstruum to prolong the heparin effect and consequently requiring less heparin are very encouraging and may bring us to use the subcutaneous route in the majority of cases.

**Dicumarol.** The action of dicumarol as described by Link is primarily on the liver in inhibiting its formation of prothrombin. The anticoagulant effect of dicumarol results only from the diminution in the available prothrombin usually necessary to clot formation. Its relative insolubility except in very alkaline solution limits its practical administration to the oral route. Admittedly it is a potentially

eration there was an occluding thrombus up to the level of the profunda in the former and up to the external iliac in the latter. In the latter case it is only fair to say that there was dilatation of the entire superficial venous tree of the extremity but not above the inguinal fold.

#### TREATMENT

It is obvious that the treatment of venous thrombosis of the lower extremities should be directed at (1) preventing propagation of an existing clot, (2) preventing embolization and (3) keeping the patient as comfortable as possible both during and after such treatment. This study is an attempt to evaluate the efficacy of anticoagulant therapy in accomplishing this purpose.

At the beginning of this study it was decided that all patients with thrombophlebitis in the University Hospitals would be treated by anticoagulants with the exception of those particularly unsuited to this form of treatment by virtue of certain contraindications, such as subacute bacterial endocarditis renal or hepatic disease purpuric diseases bleeding lesions, those preoperative cases when in the opinion of the surgeon anticoagulants were not desirable, or those postoperative cases when large bare bleeding surfaces were to be expected.

It was also decided that these patients would be treated with bed rest in moderate Trendelenburg position (the foot of the bed on 4 to 6 inch blocks) as soon as the diagnosis of thrombophlebitis was made. The only exceptions were patients with severe or acute cardiac disease patients with restricted vital capacity and those with pulmonary embolism in whom in this position pleural pain was aggravated. This method of care was prompted by the work of Bauer (5) who showed fairly conclusively that the rate of venous blood flow was increased by this position because the veins remained small and free of stasis or laking. The purpose of this procedure is to reduce to a minimum the chances of propagation of thrombi already formed and to discourage new thrombus formation further than might be done by the anticoagulants. This study was begun when the use of anticoagulants was not as well accepted as it is now and

an added safety factor was thought advisable, however small its contribution may have been for the result herein reported. It is a procedure to be recommended especially when anticoagulants are not used as put forth by Homans and others even earlier. At the beginning of the study it was also decided that no patient should receive sympathetic blocks, local or reflex heat, or other forms of therapy directed at the thrombophlebitis.

One patient received repeated sympathetic blocks for concomitant or primary peripheral arterial embolism.

*Heparin.* Since the original work of Murray and Mackenzie and of Crafoord and Jorpes (8) heparin has come into clinical use increasingly both as a prophylaxis against primary thrombosis and as a preventative against propagation of the thrombosis already existent. The recent work of Loewe and Richter even further suggests that heparin may aid in dissolution of the early clot.

By virtue of its negative charges, heparin combines with prothrombin thrombin fibrinogen and thrombokinase to prevent them from acting in their usual capacity as shown by Jorpes (14).

This drug was used in 54 of our patients, exclusively in 8 and with dicumaryl in 46. The average period of treatment for the whole group was from 2 to 8 days. The majority of patients were treated for from 1 to 2 days.

In the first 25 cases in which heparin was used this drug was given intravenously every 3 hours. A clotting time was taken as a control prior to treatment and 1½ hours after each dose. An attempt was made to keep this 1½ hour clotting time at from 2 to 3 times the control or the patient's normal. The majority of this group required 50 milligrams of heparin intravenously every 3 hours to maintain this level of clotting time. A few patients required as much as 60 to 70 milligrams for the same effect. In 3 extremely ill patients it was found that only 20 milligrams was required for the same effect. These patients were markedly debilitated to begin with and were found later at autopsy to have hepatic involvement of moderately severe degree.

On the other hand one extremely ill patient with carcinoma of the ovary and pelvic ab-

for an occasional microscopic or transient gross hematuria.

*Duration of treatment* The average duration of treatment (prothrombin time of 2 times normal or above) was 14 days. In most cases the period of treatment was between 10 and 19 days.

The patients with pulmonary embolism were treated for the longest period. These comprised the group receiving between 14 and 21 days of dicumarol treatment.

Of the patients inadequately treated (only 3 to 5 days of therapy or with a prothrombin ratio not continuously between 2 and 3) only 1 died of pulmonary embolism.

We attempted to treat our patients without embolism for a period of 14 days and those with embolism for 21 days. Those without embolism were ambulated with ace bandage support as soon as all signs and symptoms were negative (usually by the seventh day) and kept under treatment until the total period of therapy was 14 days. The patients with pulmonary embolism were kept in bed for at least 10 and in most cases 14 days and kept under treatment for a total period of 21 days.

*Bed rest* As mentioned before, bed rest was in moderate Trendelenburg position for all patients who could tolerate it. The average length of stay in bed after the onset of the phlebitis or discovery of it was 10.5 days. Most of the patients were kept in bed for 10 days or less. It is extremely difficult to decide on the proper period of bed rest. One patient experienced a nonfatal pulmonary embolism after being in bed only 4 days. Still another was allowed up only after 18 days of therapy and 2 days after being up with a normal prothrombin time developed a pulmonary embolism.

*Femoral vein ligation* Ligation of the common femoral vein was performed in 8 patients in this series for various reasons as shown in Table I. In view of the arguments concerning the possibility of involvement of the profunda vein, the incidence of undiagnosed bilateral involvement, and the anatomical points brought out by Edward Edwards (10) in his recent study, we perform bilateral ligations of the common femoral. In 1 patient with a

TABLE I—FEMORAL VEIN LIGATIONS  
IN 92 CASES OF ACUTE THROMBOPHLEBITIS

	Age Years	Reason for ligation
1. R. K.	18	Subacute bacterial endocarditis
2. O. F.	74	Phlegmonous phlebitis
3. L. L.	66	Preoperative gastrectomy for carcinoma with bleeding lesion
4. H. J.	64	Preoperative gastrectomy for bleeding carcinoma
5. F. E.	63	Postoperative transurethral prostatectomy
6. C. D.	77	Carcinoma of bladder (postfulguration) bleeding
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phlegmonous phlebitis of the saphenous parva and deep vein involvement unilateral ligation only was done. In all, a total of 15 ligations were carried out in the 8 patients.

#### TYPES OF CASES

By way of interest we have divided our cases into bland and inflammatory types. Under bland thrombosis we included those without noticeable temperature change in the extremity and usually with less evidence of inflammation such as pain, tenderness or redness. The so called cases of phlebothrombosis would fall into this group, however it is admitted that according to the criteria set up at the beginning for including cases in this study we perhaps have possibly excluded some cases of so called phlebothrombosis. Thirty seven of the patients fell into this group.

Under inflammatory thrombosis we included all the rest of the patients who of course had evidences of inflammation such as noticeable temperature elevation of the extremity, pain, tenderness and in some instances color changes. Swelling is considered by us as a sign of venous obstruction for the most part although accompanying lymphangitis and local tissue reaction probably play a role in many of these cases. There were 54 cases in this group.

*Acute iliofemoral thrombosis* The sudden swelling of an entire lower extremity is an entity often described and probably represents the sudden involvement by a thrombus of the critical level of venous drainage just proximal



dangerous drug when its action depends on the irregularities of intestinal absorption and a special effect on the liver's prothrombin production. For these reasons one must be prepared to follow prothrombin times regularly and to combat the possible results of occasional unpredictable prothrombin depletion that may result before attempting the use of this drug as outlined below.

This anticoagulant was used in 77 of our cases. The method of dosage described by Yahr and associates and by Barker and associates was followed in essence. We gave the average patient 300 milligrams of dicumarol the first day (100 mgm. per 50 pounds of body weight) 300 milligrams the second day (two-thirds of the initial dose) and 100 milligrams on the third day (one-third the initial dose) provided the prothrombin ratio (control patient) was not 1.5 or higher. Our second day dosage was divided into 100 milligram morning and evening doses which allowed a little longer spread of our therapeutic level of prothrombin ratio from the initial dosages. This latter factor came into more importance in the prophylactic group in which a simple postoperative dosage like this (300 mgm. 100 mgm. + 100 mgm. 100 mgm.) gave a prothrombin time of 2 to 3 times the normal for 5 to 6 days without further dosage in most cases.

This divided second day dosage allowed us to stop at 400 milligrams in patients who proved to react with a significantly increased prothrombin time (1.5 times normal or more) by 24 hours after the first dose.

It took an average of 2.5 days for the prothrombin times of these patients to come to 1.5 times the normal or higher. The majority of the cases came into this range of prothrombin time within 2 days. The day after the first dose was counted as the first day. In other words a prothrombin ratio of 1.5 or higher was obtained in most patients in from 24 to 36 hours.

In the early part of our experience with dicumarol we noticed some instances of bleeding from the mucous membranes, wounds, kidneys, etc. During this time we were keeping our prothrombin ratios between 4 and 5 times the normal. As can be expected by the

curves of Quick the prothrombin time shot to extremely high levels and in some instances the plasma could not be made to clot. In these cases vitamin K in doses of 72 milligrams intravenously was given and usually the prothrombin time returned to reasonable levels within 10 to 12 hours and on repeating this dose (if necessary) in another 10 to 12 hours, the prothrombin time would be normal. We found also that whole blood transfusions would bring the prothrombin time down, but the longest effect we were able to demonstrate was 9½ hours, after which time the prothrombin time gradually returned to a high level. The higher the prothrombin time, the more blood it took to bring the prothrombin time back to normal. Fresh blood was much more potent in this effect than blood 24 hours old or older.

In a few cases secondary operative procedures, such as drainage of subphrenic abscesses, were found necessary after patients had been dicumarolized. In these cases, if the prothrombin time was only between 2 and 3 times the normal, it usually sufficed to give the patient one fresh whole blood transfusion 2 to 3 hours prior to surgery and the prothrombin time was close to normal at the time of the procedure and remained so for 8 to 9 hours and then rose again. It is only fair to mention that in 1 patient being treated prophylactically and prepared as outlined subphrenic exploration was attended by a good deal of bleeding and the patient required another transfusion before bleeding was controlled.

We might cite the case of 1 patient with an old malleolar fracture requiring surgery treated for thrombophlebitis preoperatively with dicumarol until 1 week after disappearance of signs and symptoms, at which point her prothrombin time was 2.5 times the normal. She was given 128.0 milligrams of vitamin K intravenously the night before surgery and a fresh blood transfusion a few hours before surgery and went to surgery with a normal prothrombin time. Her postoperative course was uneventful.

Keeping the prothrombin ratio between 2 and 3 times the normal rather than previous higher levels, the incidence of significant bleeding all but disappeared in this series, and

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#### TYPES OF CASES

By way of interest we have divided our cases into bland and inflammatory types. Under bland thrombosis we included those without noticeable temperature change in the extremity and usually with less evidence of inflammation such as pain tenderness or redness. The so called cases of phlebothrombosis would fall into this group however, it is admitted that according to the criteria set up at the beginning for including cases in this study we perforce have possibly excluded some cases of so called phlebothrombosis. Thirty seven of the patients fell into this group.

Under inflammatory thrombosis we included all the rest of the patients who of course had evidences of inflammation such as noticeable temperature elevation of the extremity pain tenderness and in some instances color changes. Swelling is considered by us as a sign of venous obstruction for the most part, although accompanying lymphangitis and local tissue reaction probably play a role in many of these cases. There were 54 cases in this group.

*Acute iliofemoral thrombosis* The sudden swelling of an entire lower extremity is an entity often described and probably represents the sudden involvement by a thrombus of the critical level of venous drainage just proximal

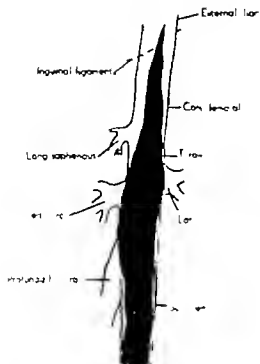


Fig. 5. Mechanism of acute iliofemoral thrombosis.

to the profunda femoris vein. At this level the profunda femoris, the lateral and medial circumflex, and a little higher the long saphenous enter the femoral vein (Fig. 5). The tail of such a thrombus and later the thrombus itself extend well into the external iliac vein, thus the term iliofemoral thrombosis. One can readily see the extent of obstruction by such a thrombus. This sudden swelling is frequently accompanied by pain and a sense of tightness in the extremity. These limbs may be warmer or cooler, dusky or paler, and the arterial pulses may be the same or less than in the opposite limb. In our series, there were 23 extremities in this category. Three of these were in patients giving a history of old iliofemoral thrombosis with a superimposed acute process.

The so called phlegmasia alba dolens of a cold white, swollen but not always painful extremity was seen in 11 instances. There was surprisingly little incidence of pain and almost no incidence of tenderness in these. Nine of these patients were in bed at the time of onset. In the 2 patients who were ambulatory at the time of onset there was appreciable

TABLE II—TYPES OF VENOUS THROMBOSIS OF THE LOWER EXTREMITIES

Type	No. Cases
Bleed thrombosis	27
Inflammatory thrombosis	54
	61
Acute iliofemoral thrombosis	20
Old iliofemoral, old acute process	3
Phlegmasia alba dolens	11
	3
Superficial thrombophlebitis	8

pain. The presence of swelling may well have accounted for the failure to elicit tenderness.

**Superficial thrombophlebitis.** During the course of this study 5 postoperative cases of superficial thrombophlebitis were seen and treated with anticoagulants. Two cases were associated with deep thrombophlebitis. Two patients suffered pulmonary embolism calling attention to an otherwise unrecognized thrombophlebitis. Two developed while the patients were being treated for deep thrombophlebitis. All of these patients went through the natural course of the disease unaltered.

**Pulmonary embolism.** There were 27 patients in this series who had pulmonary embolism. These represent 29 per cent of the entire group. This figure is a little less than the 33 per cent found for untreated cases in a similar group by Welch and Faxon and by Allen (1).

In 11 patients pulmonary embolism was the first indication of the presence of thrombosis in the veins of the lower extremities. In 3 of the patients mentioned symptoms of deep vein thrombosis did not appear until several days after the embolism. In another 10 patients the thrombophlebitis and pulmonary embolism were noted on the same day. This means that 21 or 78 per cent, of these patients already had a pulmonary embolism by the time treatment could be begun.

It is interesting to note that 13 of the patients having pulmonary embolism were those with a supposedly bland type of thrombosis and 14 were in the group of those with an inflammatory process. This result seems contrary to the common belief that the bland

process leads to pulmonary embolism more often than the inflammatory process. We do not mean to leave this impression. An autopsy study such as Hunter's could very well show such a predominance of embolus resulting from the bland process for it includes patients who had thrombosis in the lower extremities without signs. Unfortunately we were not able to secure complete autopsies including leg dissections of fatalities in our hospital during the same period as our study. It is also to be argued that patients with nonfatal pulmonary embolism and without clinical evidence of thrombosis would not fall into a series like ours or an autopsy analysis. Therefore it is probably true that pulmonary embolism is more common with bland processes than with the inflammatory ones.

Six patients developed pulmonary embolism while actually on anticoagulant therapy. They cannot all be considered to have had adequate treatment however. This number includes a patient who was adequately treated for 18 days with anticoagulants. Two days after her prothrombin time had returned to normal while up and around, she developed a small nonfatal embolism. After 11 more days of anticoagulant treatment she had no further trouble. This patient and one other who died were the only 2 patients who developed an embolism while treatment supposedly was adequate. The 4 remaining patients had pulmonary embolism on the first or second day after treatment was begun and so in a sense were not adequately treated. These 4 patients added to the 21 who had pulmonary embolism to begin with make 25 or 92 per cent of this group who had pulmonary embolism before anticoagulant treatment could become effective.

There were 5 deaths in our series. In only 1 can we consider pulmonary embolism as the primary cause. All of these patients were seriously ill and except for the 1 fatality mentioned, slowly succumbed to diseases other than pulmonary embolism. Three of these patients however were found to have pulmonary emboli present at autopsy but these were not thought to be the cause of death. For the evaluation of the reader a summary of the fatal cases follows.

Patient	Hospital No.	Treatment	Autopsy findings
N. B.	781977	Adquate anticoagulants	Massive pulmonary embolism; carcinoma of pancreas
S. H. K.	77 545	Inadequate heparin therapy stopped 5 days prior to death	Far advanced ulcerative colitis with toxemia. Incidental pulmonary embolus
S. L. L.	751808	Bilateral femoral ligation preoperatively	Tension pneumothorax; incidental pulmonary embolus
A. M.	770417	Inadequate heparin therapy stopped 4 days prior to death	Carcinoma of pancreas with generalized metastases and incidental pulmonary embolus
S. A. K.	777475	Inadequate heparin therapy stopped 5 days prior to death	Far advanced biliary cirrhosis of the liver with external biliary fistulas

According to the data presented by Welch and Faxon about 30 per cent of the patients who have one pulmonary embolus from a thrombophlebitis will have another. They also indicate that about 25 per cent of the group of patients with one embolism will have a fatal embolism. In our series there were only 2 secondary pulmonary emboli and neither of these proved fatal.

In 19 of our cases there were x ray findings characteristic of pulmonary embolism. As can be seen by Table III most of the emboli produced x ray evidence on the right side and showed a preference for the lower lobes. This has been observed and commented on by Roessler, Allen (2) and others. In some cases clinical evidence of pulmonary infarct was present in the lower lobes but was not recognized on the ordinary chest film because of interference by the diaphragm or heart shadows. In such cases roentgenograms in the lateral projection or with overpenetration are indicated in order to substantiate the diagnosis made.

TABLE III — LOBES INVOLVED IN PULMONARY EMBOLISM AS PROVED BY X RAY EXAMINATION

	Right		Left
Upper	3	Upper	
Middle	4	Lower	3
Lower	1		
Total	18 (75%)		3 (12%)

1 lobes

TABLE IV — ASSOCIATED FINDINGS WITH PULMONARY EMBOLISM IN THROMBOPHLEBITIS

	No. cases	Percent
Blind process	14	51.8
Inflammatory process	13	48
Signs of thrombosis 3 to 5 days after embolus	3	11.1
Chest pain	9	30
Hemoptysis	12	43.5
X-ray findings	19	70
No x-ray findings	8	29
After surgery	5	17.9

**Chest pain and hemoptysis** It can be seen from Table IV that a good portion (70 per cent) of the patients had chest pain and hemoptysis. Chest pain was the most common symptom. A few patients had upper abdominal pain and a few had shoulder-strap pain at the onset of the embolism. Hemoptysis began usually within the first 24 hours after the embolism. An occasional patient did not cough up bloody sputum for several days and others had cough without sputum and some neither cough nor sputum.

**Hemorrhagic manifestations** It can be seen from Table V that except for patient A K all of the patients in this series who had hemorrhagic manifestations were those on dicumarol and with a prothrombin ratio of 4 or over. These cases prompted us to lower our period of treatment with dicumarol. In patients in the latter half of our series and to date, we have endeavored to keep the prothrombin ratio below 4 and preferably between 2 and 3. After this change in our form of treatment we noted a marked decrease in hemorrhagic manifestations with only an occasional transient hematuria or hemorrhagic skin lesion.

**Hematuria** Except for patient S R. upon whom a posttransurethral prostatectomy was performed, the urinary bleeding was not a source of concern in this group even though grossly visible in 8 cases. In all except patients S R. and H M. no change was made in the treatment and no special measures were taken to stop the bleeding. In all of these latter instances hematuria cleared up sponta-

aneously within 3 days. Within 24 hours after disappearance of gross blood and in most instances sooner no microscopic evidence of blood could be found in the urine. This observation was checked by examination of separate urine specimens every 4 hours after the onset of gross hematuria. At first the patients with microscopic hematuria were checked only daily and as soon as the findings were negative examination was made only every 2 days. All of our patients had a routine urinalysis every other day. In no instance was microscopic hematuria reported prior to a pink or red urine being observed grossly. These findings have been noted in our prophylactic series also and suggest that dicumarol therapy might in some way at least be responsible for one or more small renal arteriolar or even capillary accidents from which recovery is rather rapid even when the patient is continued on the treatment. We have observed that some other patients treated with dicumarol had multiple episodes of transient hematuria.

**Skin manifestations** Peculiar hemorrhagic skin lesions in our patients treated with dicumarol were observed. These lesions were accompanied by a burning pain and extreme tenderness. We have seen 4 lesions (3 appearing in this series as shown in Table V) which suggested a resulting necrosis but all healed spontaneously within 10 days. Here again as in the transient hematuria, one might easily postulate some small arteriolar or capillary damage somehow related to dicumarol therapy.

No other skin lesions have been noted in our dicumarol treated patients suggestive of sensitivity or toxicity attributable to dicumarol.

#### PRIMARY CONDITION

To correlate the incidence of thrombophlebitis with various other conditions, an analysis of the primary diagnoses for which the patients were in the hospital was made. Other associated factors such as operations and in some cases other concomitant diseases were analyzed.

**Thrombophlebitis** In 9 patients or 10 per cent deep thrombophlebitis was the primary disease. A careful historical and physical re-

TABLE V —HEMORRHAGIC MANIFESTATIONS IN PATIENTS ON ANTICOAGULANT THERAPY FOR THROMBOPHLEBITIS

Patient	Flow. No.	Anti-coagulant used	Hematuria duration		Purpuric manifestations			Gastro-intestinal	Mucous membrane	Uterine	Remarks
			Days Gross	Micro	Hematomas	Toxic erythema	Echymosis				
P. F.	77263	D									25 mgm. vitamin K. + transfusion
S. R.	768639	D	7	8					Oozes 3 days		Posttransurethral prostatectomy. Six transfusions 300 mgms. vit. K. Liver function O. K.
M. W.	783940	II			Butt cheeks						Cleared up spontaneously
R. N.	768693	II						Rectum 2 days			Polio case. 60 mgms. vit. K. Liver function O. K.
T. N.	77103	II	4	4						Menstr 3 days	Polio case. Cleared up spontaneously
H. K.	777548	H						Rectum 10 days	Oozes 10 days		Biliary cirrhosis. Heparin discontinued but bleeding continued. Not serious.
E. G.	775890	D								Menstr 5 days	No treatment.
O. S.	765351	D	2								Cleared up without treatment
F. A.	772603	D	3	3				Thrombocyt 5 days			Regional enteritis, post resection and ileostomy N treatment.
H. M.	777923	D		?							60 mgms. vit. K. Hematuria persisted for more than a week. Postvaginal and bladder cirrhosis.
E. D.	772624	D			Thigh						Cleared up spontaneously
A. E.	777476	H							Oozes		Heparin stopped 5 days ante mortem. Extremely ill ulcerative colitis case
O. F.	670643	D									Cleared up spontaneously
H. W.	7718	D			Elbow						Ten days post partum. Cleared up spontaneously
J. D.	77237	D			Thigh						Cleared up spontaneously
J. W.	642 mg	D					Leg				Cleared up spontaneously
E. N.	608863	D			Sub-phrenic						Infected hematoma   drained sub-phrenic abscess. Necrosis of liver 1 post mortem.

view of systems revealed no other significant concomitant disease. On the other hand Miller and Rogers reported a primary diagnosis of thrombophlebitis in 30 per cent of their patients a series similar to ours in numbers at least.

**Cancer** The high incidence of thrombophlebitis in patients with cancer has long been noted (19) and is seen in our study also. The reason for this is not yet fully apparent. In patients with thrombophlebitis one should always suspect and look for a neoplastic process when there is no apparent causative factor for the thrombosis. In 1 of our cases it was not until postmortem examination that a carcinoma of the pancreas was found.

Cancer was a concomitant or primary disease in 38 of our patients. Of these 14 had not been operated upon. The relatively higher

TABLE VI —CANCER IN 92 CASES OF THROMBOPHLEBITIS

	No. cases
Stomach.	9
Large bowel	7
Ovary and uterus	7
Prostate.	4
Bladder	3
Breast.	2
Pancreas	2
Tongue.	1
Brain	1
Small bowel	1
Lung	1
Total	38

TABLE VII.—POSTOPERATIVE THROMBOPHLEBITIS IN 92 CASES OF THROMBOPHLEBITIS OF THE LOWER EXTREMITIES

Operation	Total Operations	Thrombophlebitis Number	Per cent
Gastric resection cancer	477	2	0.4
Colon resection cancer	441	4	0.9
Hip fixation	88	4	4.5
Hysterectomy cancer	74	1	1.4
Prostatectomy	1	1	100
Cholecystectomy	15	3	20
Hernia	60	3	5
Amputation	22	3	13.6
Oophorectomy	1	1	100
Otitis and cartilage	92	1	1.1
Small bowel resection cancer	70	1	1.4
Bladder resection (all cancer)	7	1	14.3
Radical mastectomy	22	1	4.5
Paracervical cancer	1	1	100
Colostomy cancer	10	1	10
Shoulder amputation	1	1	100
Craniolepsy cancer	144	1	0.7

incidence of thrombophlebitis in postoperative cancer patients as compared with noncancer patients is shown in Table VII.

The comparatively high number of cases of gastrointestinal, gynecological, and genitourinary cancer in this series (Table VI) is due to the fact that our hospital receives an inordinate number of cases of gastrointestinal cancer and gynecological and genitourinary cancer compared with other institutions.

**Pregnancy** Two patients in this series were pregnant when thrombophlebitis developed. One was in the middle of the third trimester and the other in the first trimester. Both patients were given a full course of dicumarol under our plan and reacted favorably. One was given a second prophylactic course beginning on the day of delivery and had no adverse effects. The other was delivered and followed without dicumarol prophylaxis and her progress also was good.

**Post partum** Two other patients were noted to have thrombophlebitis within the

first 10 days post partum and were given a course of dicumarol by our plan. In both cases progress was satisfactory. In no case was nursing of the young allowed during the mother's dicumarol treatment because of the possible deleterious effect on the infant. This is still a controversial point and so a conservative attitude was adopted by our obstetric and pediatric staffs.

These results and the observations on 3 patients who had normal menses during treatment with dicumarol (Table V) would lead us to think that the uterus is little affected by dicumarol as used here. Our observations certainly are in accord with the fine work of Barnes and his associates.

**Postoperative cases** Again, the predominance not only of gastrointestinal and gynecological cases but also of fractured hips is noted in this group. The predominance of gastrointestinal cases is probably due to the disproportionate frequency of these operations here due to the special interest of our staff in these conditions. These 38 postoperative cases represent 41.0 per cent of the entire series.

**All other conditions** Of all the fractures of the lower extremity seen in our hospital during the period of this study only 4 were treated with traction alone. None of these patients developed evidence of thrombophlebitis of the lower extremities.

The relative absence of surgery in our cases involving the hip or lower extremity would seem to indict surgery but this would be unfair. In most of our cases of fracture treatment was by internal fixation casts, or both. Patients with fractures of the lower extremity (the majority of the hip) admitted usually a week or more after their fracture and often for secondary reparative surgery represent the great bulk of our operative fracture cases. These facts taken into due consideration would account for the figures as they stand. During the period of our study there were 60 hip operations for fracture in our hospital. In 4 or 6.6 per cent of these thrombophlebitis developed (Table VII).

The early part of our study was contemporary with the great poliomyelitis epidemic of 1946. Seven patients with poliomyelitis

were examined for the presence of thrombophlebitis. In all the patients examined with the signs and symptoms of poliomyelitis it was easy to identify those with thrombophlebitis. Only 3 cases however are included in this series. In these cases the thrombophlebitis occurred in the postinflammatory state of the poliomyelitis when the signs of swelling heat in the extremity and elevation of vital signs should not have been caused by the poliomyelitis. Muscle pain and tenderness while present could not be used as evidence as they are common to both diseases.

That we may have missed some cases of thrombophlebitis in those seen in the acute stage of poliomyelitis and that some or all of the cases we included may have been exacerbations of poliomyelitis is not denied.

The incidence of cardiac disease as recorded is low because only those patients without other disease are included. A great number of our patients had cardiac disease along with their other difficulties but no special effort was made to correlate this finding as a separate entity.

As has been noted by Dennis, the incidence of thrombophlebitis in ulcerative colitis is about 30 per cent. In full cognizance of this fact all patients with ulcerative colitis operated upon in our hospital for ileostomy are given prophylactic anticoagulants. As a result none of our patients with ulcerative colitis having ileostomy operations has developed thrombophlebitis since this prophylaxis was instituted.

#### RESULTS

All of our results must be considered from the standpoint of our entire method of treatment which includes anticoagulants as the main instrument. Without anticoagulants the bed rest in Trendelenburg position plays a large role, in our opinion in getting our patients well and preventing pulmonary embolism.

As has been stated, there were no cases of secondary fatal pulmonary embolism and only 2 cases of pulmonary embolism after or during supposedly adequate treatment. There was only 1 fatality in the entire group supposedly adequately treated with anticoagulants.

Following is a résumé of the average number of days before return to normal of or relief from vital signs, 4.8 days (majority 3 to 4 days), pain 4.0 days (majority 3 to 4 days), tenderness 8.0 days (majority 5 to 8 days), swelling 2.0 days (majority 1 to 2 days).

Actually nur 27 patients with pulmonary embolism represent 20 per cent of the entire series, a little less than the 33 per cent incidence of pulmonary embolism usually found in untreated thrombophlebitis.

#### CONCLUSIONS

Our observations lead us to believe that the most indicative signs in venous thrombosis of the lower extremities are swelling, tenderness, temperature change, and pain. The high incidence of deep calf tenderness in our series leads us to rely more on this sign than on the presence of tenderness to calf squeeze or a positive Homans' sign. However we consider calf squeeze tenderness and a positive Homans' sign as necessary adjuncts in making a diagnosis but when present alone they are probably not as dependable as deep calf tenderness. Color changes, dilatation of superficial veins, and increase in vital signs are helpful when present but probably not of great significance in making a diagnosis of deep vein thrombosis due to the infrequency of their occurrence.

The use of anticoagulants in the treatment of our patients has been very encouraging to date and has reduced the incidence of secondary embolism from an expected 30 per cent to 2.17 per cent. It has reduced the rate of secondary fatal embolism from an expected 25 per cent to zero. The use of anticoagulant treatment has not significantly affected the over all incidence of primary pulmonary embolism. This cannot be considered as a deficiency of the treatment because most of our patients with pulmonary embolism had already had the embolism at the time of the diagnosis of thrombophlebitis. It would seem to emphasize the value of prophylaxis.

We are impressed with the high incidence of thrombophlebitis in patients with cancer and believe that these patients should have prophylactic postoperative use of anticoagulants. Such prophylaxis seems to be indicated in patients having major gastrointestinal opera-



tions, hysterectomies, and hip fixations, especially those with cancer.

We believe the use of anticoagulants with bed rest in mild Trendelenburg position is a satisfactory way of treating thrombophlebitis. Ligations are also indicated in some cases. We do not believe sympathetic blocks necessary for the treatment of acute thrombophlebitis of the lower extremity.

For the most part, the use of dicumarol keeping the patient's prothrombin time at 2 to 3 times normal for 14 days with the patient ambulatory for at least the last 7 days is probably an adequate course of therapy for deep vein thrombophlebitis.

It appears that the use of heparin in 50 milligram doses intravenously every 4 hours omitting the 4:00 a. m. dose may well be an adequate form of treatment. Our experience with this method is still too limited to draw any just conclusions as yet. This is also true of our small experience with heparin in Pitkin's menstruum.

It is likely that the answer to the question of thrombophlebitis does not lie in perfecting the anticoagulants and their administration but rather in the fundamental cause of abnormal blood clotting.

#### SUMMARY

1. Ninety two cases representing 105 extremities with deep thrombophlebitis of the lower extremities are presented.

2. The incidence of diagnostic signs and symptoms are recorded and evaluated.

3. A method of treatment with heparin and dicumarol used in 84 of the cases is presented.

4. The cases of 8 patients who were treated with ligation are also presented.

5. Twenty three cases of acute iliofemoral thrombosis including 11 cases of so called phlegmasia alba dolens are presented.

6. The incidence of pulmonary embolism before and after anticoagulants is discussed.

7. The complications of anticoagulant therapy are presented and discussed.

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# THE SURGICAL MANAGEMENT OF ULCERATIVE COLITIS

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**I**N recent years the therapy of ulcerative colitis has undergone a radical change. Advances in preoperative preparation and in postoperative care have made surgery safer. As a result more patients are being treated by surgical measures and more radical operative procedures are being recommended. In the past the aim of treatment has been to put the diseased bowel at rest by diverting the fecal stream with an ileostomy. Although this form of management gives good results in some cases it is now realized that when extensive pathological changes have occurred in the bowel wall it never reverts to normal. Continuity of the intestinal stream can seldom be restored without grave danger of recurrence. The diseased bowel may also act as a focus of infection which prevents complete restoration to health. Furthermore the possibility of polyposis and malignant degeneration always exists. Consequently as surgery has become safer there has been an increasing tendency to follow initial ileostomy with resection of the colon in one or more stages (9). The results of colectomy have been relatively good. Cattell (2) states that three quarters of the patients thus treated have remained well and have been able to resume their former occupations. Others have had a similar experience. The purpose of this paper is to present the technique of surgical management which we have adopted at the Royal Victoria Hospital.

## SELECTION OF CASES FOR OPERATION

Ulcerative colitis is a disease of variable severity and relatively few cases demand surgical treatment. In most clinics 20 to 25 per cent of all patients come to operation. It must be remembered that surgery is only indicated in intractable or complicated cases and as a rule anyone that undergoes operation represents a medical failure. For this

reason comparison of the results and mortality of medically and surgically treated groups is unfair and gives little indication of the value of any procedure.

Clinically cases of ulcerative colitis can be divided into three groups.

*Group I* The acute fulminating type with extreme toxemia, massive hemorrhage, and rapidly downhill course. The results of treatment are poorest in this group. Surgery offers little prospect of alleviation and carries a prohibitive mortality. Patients so afflicted should be treated medically with antibiotics and blood transfusion. Crohn (6) has stated that streptomycin is sometimes of value. The medical ileostomy with the Miller Abbott tube may also be useful (11). If operation is contemplated it must be performed early before the patient is in a moribund condition.

*Group II* Chronic cases of moderate severity characterized by remissions and exacerbations. Most of the surgical patients fall into this group and the indications for operation may be classified as follows:

1 *Intractable cases* These follow a downhill course with increasingly frequent and severe exacerbations which cannot be controlled by medical therapy. Episodes of diarrhea and bleeding recur and weight loss, anemia and liver damage become more marked. In the past such patients have been subjected to operation as a last hope. With improved preoperative preparation, and a feasible means of controlling the ileostomy, earlier surgical intervention is indicated.

### 2 *Complicated cases*

a *Perforation* This complication occurs in about 1 per cent of patients. It is especially likely in acute cases or chronic cases with stricture formation. A virulent form of peritonitis results which is almost universally fatal. In most instances there are warning signs of impending perforation and these must be regarded as an urgent indication for surgery.

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*b Stricture formation* Narrowing of the bowel lumen due to scarring occurs in 5 per cent of cases of ulcerative colitis. The commonest site is in the rectum. As a rule the stenosis is not severe enough to cause complete intestinal obstruction. The lesion is irreversible and demands surgical treatment.

*c Polyposis* This represents the most common complication in chronic cases, the incidence being 10 per cent. The lesions are pseudopolyps, representing hyperplastic islands of epithelium between the ulcerated areas. Polyposis constitutes an indication for surgery because of the danger of recurring hemorrhage and malignant degeneration.

*d Carcinoma.* There has been some controversy about the frequency of malignant change in chronic ulcerative colitis. Lynn found an average incidence of 2 per cent in a large series of cases. Cattell and Boehme (4) feel that the true prevalence is greater than the reported figures. It appears likely that with more patients surviving longer periods because of improved medical therapy the incidence of carcinoma may become higher. The tumors that develop in these patients are extremely malignant and metastasize rapidly. The slightest suspicion of carcinoma demands early radical surgery.

*e Massive hemorrhage* Bleeding is fairly common during exacerbations of the disease but massive melena is relatively rare. When it does occur it constitutes a very serious complication and carries a high mortality. If conservative treatment does not control hemorrhage within 48 hours, surgical intervention is indicated.

*f Abscess and fistula formation* These are local complications which arise as a result of infection and ulceration in the colon or rectum. Persistent fistulas result from opening of abscesses into the surrounding tissues or neighboring organs. The only effective treatment is diversion of the fecal stream and subsequent excision of the diseased bowel. If the rectum is not removed symptoms persist despite ileostomy and colectomy.

*3. Segmental ulcerative colitis (7)* This represents a rare form of the disease in which the lesions are limited to an isolated segment of the colon. Such cases can be cured by resection

of the involved bowel. This should be done early to avoid further extension of the pathological process.

*Group III* Many patients have a very mild type of disease in which pathological changes are not severe and symptoms constitute an inconvenience rather than a disability. They rarely develop complications and the mortality is low. Such cases respond well to medical and psychiatric therapy and do not require surgical intervention unless complications or severe exacerbations ensue.

#### PREOPERATIVE PREPARATION

The most frequent cause of morbidity in the surgery of ulcerative colitis has been the failure to prepare these patients adequately for operation. The local lesion in the bowel is invariably accompanied by nutritional deficiencies, anemia, sepsis, and toxemia. These are usually of long duration and their correction requires an intensive preoperative regimen. The chief aims are to control symptoms, to restore nutrition and to combat infection. In most cases the patient can be returned to excellent condition and the risk of operation is greatly reduced.

*Control of symptoms* Abdominal cramps and diarrhea are usually the outstanding complaints. These can be alleviated to some extent by a bland low residue diet, absorptive powders such as bismuth and kaolin and sedative drugs. The psychic aspect of these patients should not be neglected. It is useless to attempt psychotherapy as a primary means of treatment when severe organic changes have occurred in the bowel. However symptomatic relief may often be obtained and the patient can be prepared for the inevitable mental disturbance of an operation and a subsequent ileostomy.

*Nutritional deficiencies* Hypoproteinemia is common in these patients due to inadequate intake, impaired absorption and excessive loss in the bowel. It is important to realize that the plasma protein level is maintained at the expense of the tissues and a marked degree of deficiency may occur with little change in the blood. It is safe to assume that all patients with chronic ulcerative colitis are in an actual or potential state of protein deficiency. The



Fig. 1. Barium enema. Extensive ulcerative colitis involving the entire large bowel.



Fig. 2. Barium enema. Ulcerative colitis with polyposis involving the entire colon.

best form of treatment is a high protein diet. The requirements may be 200 to 300 grams a day and to reach this the diet must be supplemented by concentrated feedings. If a sufficient oral intake cannot be achieved the requirements are met by tube feedings through a nasal catheter or by the intravenous use of whole blood, concentrated plasma and protein hydrolysates. This therapy must be continued until the deficiency is fully corrected. Restoration of a positive nitrogen balance often gives rise to dramatic improvement in the patient's condition.

Vitamin deficiencies are also common. Administration of the B complex and vitamin C in adequate dosage is necessary to restore the nutritional status to normal. There is no indication that lack of any specific vitamin plays a part in the etiology or progress of the disease. The deficiencies that exist are part of the general picture of malnutrition. Liver damage of varying severity is not unusual (5). This may give rise to a prolonged prothrombin time which aggravates the bleeding tendency.

Vitamin K must be administered in sufficient dosage to overcome this.

Anemia is a constant finding in severe cases due to blood loss, malnutrition, liver damage and perhaps to toxic depression of the bone marrow. Beneficial effects have been reported from the use of liver extract and this should be given as part of the preoperative preparation. There is no satisfactory substitute for whole blood as a means of restoring the hemoglobin to normal levels. Repeated small transfusions seem to be utilized better than occasional large ones. Blood is a good source of protein and also supplies certain nonspecific factors which appear to be of benefit in the chronically ill patient.

Because of diarrhea the water and electrolyte balance may be disturbed. This factor must be corrected in the preoperative period by careful administration of physiological saline and glucose saline.

*Control of infection.* Many papers have appeared in the literature reporting good results from the use of chemotherapeutic agents in



its removal immediately decreases toxic absorption with its consequent systemic effect. Besides removing the toxic focus of the right colon this procedure saves at least one stage in total colectomy. We also feel that such a plan of operation avoids certain complications which occur frequently with other methods. In reviewing the cases of ulcerative colitis treated at the Royal Victoria Hospital in the last 10 years we have noted the following tendencies:

1. In a large percentage of cases simple ileostomy fails to relieve symptoms and it is difficult to build the patient up sufficiently for a subsequent colectomy. Following later resection of the right colon many of these patients showed improvement.

2. Any procedure which involves anastomosis of the diseased bowel is extremely hazardous. In 6 cases in which colectomy was done with ileosigmoidostomy the mortality was 50 per cent. In all cases death was due to peritonitis.

The operation is carried out under spinal anesthesia. A long right rectus incision is made and the ileum is divided 10 to 12 centimeters from the ileocecal valve in an area free from disease. The proximal end of the bowel is brought out through a stab wound 6 centimeters below the umbilicus and 3 centimeters to the right of the midline. This is the optimum site for the use of the Koeng Rutzen bag (8). The terminal ileum and the right half of the colon are then removed in the usual fashion and the proximal end of the divided transverse colon is exteriorized through a stab wound. We feel that it is dangerous to attempt inversion of the diseased bowel and the stoma can be used for future irrigations and instillation of antibiotics. Silk technique is used throughout and the incision is closed without drainage with stainless steel wire.

There is usually a remarkable improvement following this procedure. Symptoms subside and weight is rapidly regained. In some cases the benefits are so marked that it is difficult to persuade the patient to undergo another operation. Excision of the remaining bowel is definitely indicated if there has been severe rectal involvement, polyposis, stricture or anorectal fistulas. If the distal colon is not re-

moved it should be examined periodically by proctoscopic and x-ray visualization.

The second stage is carried out in 6 months after careful preoperative preparation. Through a left rectus incision the remaining colon is resected to the level of the rectosigmoid. If the patient's condition is good and the disease involves the rectum this stage may be done as a combined abdominoperineal resection. The two team technique which we have used in cancer operations enables us to perform this in a short time with little added risk. We feel that complete colectomy is usually necessary to obtain the best results. In some cases we have shortened the interval between stages with no ill effects.

#### POSTOPERATIVE CARE

In the immediate postoperative period the chief aims of treatment are to prevent shock, combat infection, and replace the fluid and electrolyte loss from the ileostomy stoma. Blood transfusion, intravenous saline, and the administration of penicillin and streptomycin have solved these problems to a great extent.

Later the question of ileostomy care becomes important.

At the time of operation a catheter is fixed into the projecting ileum with a pursestring suture. This catheter is connected to an intermittent suction device on return to the ward. As a rule this measure protects the skin for 48 to 72 hours and then the catheter becomes loose. Skin excoriation is difficult to prevent but with careful nursing and frequent dressings it can be kept to a minimum and has not constituted an insurmountable problem in any case. Many substances have been recommended to prevent skin digestion: Aluminum powder, kaolin, ground beef, and Lassar's paste have all been used in our series. No one has proved to be of outstanding value.

Seven to 10 days after operation an adjustable type of ileostomy bag can be used and in 2 months when the stoma has shrunk the patient can be fitted with a made-to-measure Koeng Rutzen bag. This apparatus has revolutionized the care of the ileostomy and it is now safe to say that a properly made ileostomy is no more troublesome than a colostomy. As time passes the ileal contents become more

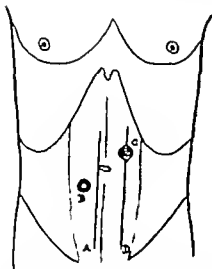


Fig. 3. Diagram of incision used in two stage colectomy. A Incision for right hemicolectomy. B site of ileostomy. C site of exteriorized transverse colon. D incision for second stage colectomy.

ulcerative colitis. In most of these the follow up has been inadequate and the prevalent opinion at the moment is that no antibacterial agent is of specific value in this disease (1). This has been our own experience.

From the surgical standpoint sterilization of the bowel contents is vitally important. Even though infection may be a secondary matter it is responsible for many of the complications and deaths that result from surgical intervention. The use of sulfathalidine, streptomycin, and penicillin makes operation safer. The routine we have adopted is to give sulfathalidine for 5 to 6 days prior to operation supplemented by streptomycin orally for the last 48 hours. In the postoperative period penicillin and streptomycin are given by intramuscular injection. With this method the bacterial count of the feces is reduced to an extremely low level and there is often an improvement in the local manifestations of the disease. The dangers of peritonitis and wound infection are minimized in the postoperative period.

#### OPERATIVE PROCEDURE

It is almost always possible to plan an elective attack in a well prepared patient. In the past the surgical mortality has been high and two-thirds of the deaths have occurred in cases in which operation has been carried out

as an emergency (2). Emergency operations should be avoided wherever possible.

The operation of choice has usually been an initial ileostomy which is followed in 6 months by a staged resection of the colon. We feel that a permanent ileostomy is the price which must be paid for a satisfactory result. Closure of the ileostomy leads to recurrence in a large percentage of cases.

If the fecal stream is diverted and the colon left *in situ* the patient may improve symptomatically but the dangers of sepsis, hemorrhage and malignancy are still present. It seems to be well established that the only way to produce a lasting cure in most cases is by complete excision of the involved bowel.

It is not advisable to anastomose the ileum to the rectal stump because in the majority of patients the rectum and rectosigmoid are the most involved parts of the bowel and an abdominoperineal resection may be necessary to eradicate the disease.

Ravitch and Sabiston have advocated a pull through type of operation in which the ileum is brought down through the intact anal sphincter resulting in a continent anal ileostomy. This procedure offers a great deal of promise but it is still too new to assess its end results.

We have adopted the policy of performing ileostomy with right hemicolectomy as an initial procedure in ulcerative colitis. The idea began accidentally when one of us (G.G.M.) was obliged to resect the right colon because of multiple perforations in a very ill patient. The result was surprising. The patient improved dramatically, her fever subsided and she began to put on weight. The resected bowel was literally "a bag of pus." It was considered that removal of the right half of the colon as an initial procedure might eradicate a source of infection and thus enable the patient to respond more quickly. This operation has subsequently been carried out in 6 patients with no deaths, and uniformly good results. We feel that it is less radical than it appears to be at first glance and that with proper preoperative preparation it can be done with a lower mortality than simple ileostomy. The benefits are obvious. Since the right half of the colon is the absorptive part of the bowel

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Fig. 4. Photograph of patient, Case 1, wearing the Koenig-Rutzen bag.

solid and less irritating and the patient can lead an active life.

To date we have not attempted a pull through operation to form a continent anal stoma. If such a procedure is contemplated it would appear wise to wait 6 to 8 months until the ileostomy discharge becomes relatively solid and nonirritating.

#### CASE REPORTS

The following case reports illustrate some of the problems involved in the surgical management of ulcerative colitis.

**CASE 1.** Patient R. R., male, aged 36 years, was admitted to the Royal Victoria Hospital September 25, 1946. He had been comparatively well until 3 months before admission at which time he began to have diarrhea and slight bleeding associated with his bowel movements. The melena became more severe and he required transfusion on several occasions. There was a rapid loss of weight (40 lbs.) during the next few months.

On admission he was pale, emaciated and appeared moderately ill. Investigation by barium enema and proctoscopic examination revealed an extensive ulcerative colitis with polyposis involving the entire colon (Fig. 4).

The hemoglobin was 68 per cent and the plasma protein level was 4.28 grams per cent on admission. The protein fell to 3.65 in the next week despite a high protein diet and blood transfusion. Latent whole blood plasma and amigen therapy was then commenced and the plasma protein level rose steadily to reach a height of 6.0 grams per cent at the time of the first operation (Fig. 5). On October 18, 1946, ileostomy and right hemicolectomy were performed. Extensive disease of the whole colon, as found and the mesentery was thickened and edematous.

The postoperative course was complicated by obstruction of the ileostomy stoma which necessitated revision on November 7, 1946. Following this he began to gain in weight and strength and his plasma proteins continued to rise to reach a level of 7.19 grams per cent with a hemoglobin of 86 per cent. On November 20, 1946, a second stage colectomy was performed. The entire remaining colon and rectum were resected by a two team abdominoperineal procedure. During this operation a large pelvic abscess was opened contaminating the peritoneal cavity. The postoperative course was stormy being complicated by a low grade peritonitis due to *Bacillus coli*. This was successfully treated with streptomycin and penicillin and the patient was discharged December 18, 1946. He has remained well since that time. His ileostomy functions well and he is comfortable and active using the Koenig-Rutzen bag. He has no symptoms and his weight and general health are completely restored.

This case demonstrates several important points.

1. The state of hypoproteinemia and the massive protein intake required to overcome it.

2. The complication of low grade peritonitis which may result from perforation with local abscess or from cutting through infected mesenteric lymph nodes. This danger necessitates the use of streptomycin and penicillin in the postoperative period.

3. The short time interval between the two stages was due to the fact that carcinoma was suspected because of the pelvic mass which turned out to be an abscess.

4. The profuse ileostomy drainage in the first few postoperative days. This must be carefully measured and the fluid and electrolyte loss replaced. It has been estimated that 7 grams of sodium chloride is lost in each 1000 cubic centimeters of ileostomy drainage (Fig. 6).

**CASE 2.** Patient D. M., female, aged 22 years, was admitted to the Royal Victoria Hospital July 31,

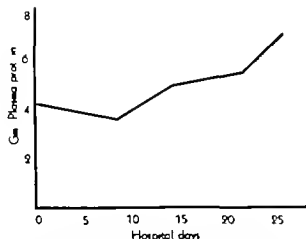


Fig 5 Case 1 Response of plasma protein level to parenteral infusion

Blood	750	1000	1000	1000
Plasma	500	500	1000	500
Amigen	2000	5000	3000	2000

1946. For 3 months before admission she had noticed increasing weakness and loss of weight. About 6 weeks after the onset of these symptoms she began to have severe diarrhea with blood and mucus appearing in the stool. She was admitted to hospital in her home town and treated with penicillin, sulfadiazine and blood transfusion. This regimen did no good and she was advised to come to Montreal.

On admission the patient was pale emaciated and ill. Physical examination revealed no significant findings.

Barium enema and proctoscopic examination established the diagnosis of an extensive ulcerative colitis with polyposis. The disease involved the entire colon with the exception of the cecum. Culture of the stool, parasite search, and allergy investigation all yielded negative results.

On admission her hemoglobin was 68 per cent and her plasma protein level 3.85 grams per cent.

The patient was acutely ill and ran a spiking fever of 102 to 103 degrees. She was treated with sulfathiazine, penicillin, and blood transfusions and an attempt was made to restore her nutrition. Despite these efforts her course continued downhill and on August 25, 1946 she was transferred to surgery.

She was put on intensive intravenous protein therapy with massive blood and plasma infusions. With this her plasma proteins rose to 6.08 grams per cent and her condition improved. On September 10, 1946 under spinal anesthesia ileostomy and right hemicolectomy were performed. The postoperative course was uneventful, whole blood transfusion, sulfadiazine, and penicillin were continued. Her condition improved rapidly and she began to gain weight. She continued to run a low grade fever and to have discharge of blood and pus per rectum. Irrigations of sulfathiazine through the colostomy opening gave some relief and she was discharged November 24, 1946 markedly improved.

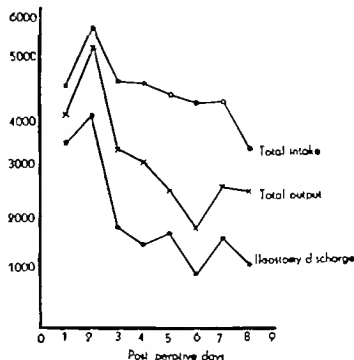


Fig 6 Case 1 Chart of intake and output in post-operative period, illustrating ileostomy loss in the first 48 hours.

The patient was readmitted June 3, 1947. She had been well in the interval and her ileostomy was controlled with the Koenig Rintzen bag. She had gained weight and her plasma protein level was 6.2 grams per cent. Laparotomy was undertaken June 11, 1947 after a preliminary course of sulfathiazine and streptomycin. A pelvic abscess was found and drained and the abdomen was closed. The postoperative course was uneventful and on October 7, 1947 the abdomen was again opened and second stage colectomy carried out leaving the rectum *in situ*. The postoperative course was smooth and the patient was discharged October 18, 1947. Since that time she has remained well.

This case represents the more acute fulminating type of disease. The improvement following right hemicolectomy was dramatic. The problem of restoring protein nutrition was again troublesome and large amounts of oral and parenteral protein were necessary to maintain nitrogen balance. It has been shown that these patients may lose as much as 25 grams of protein daily in the stools alone. The complication of peritoneal infection was again present and required intensive antibiotic therapy.

#### SUMMARY AND CONCLUSIONS

1. The indications for surgery in the treatment of ulcerative colitis are discussed. Op-

eration should be reserved for intractable or complicated cases and cases with segmental bowel involvement

2 Preoperative preparation is important. The aims are to restore nutrition, control infection and alleviate symptoms. Restoration of a positive nitrogen balance may be difficult and require large amounts of protein orally and parenterally

3 The initial operative procedure of choice is an ileostomy with right hemicolectomy followed in 6 months or less by resection of the remaining diseased bowel

4 The chief problems in the postoperative period are the control of infection which requires the use of streptomycin and penicillin and the replacement of fluid and electrolyte loss from the ileostomy

5 The diseased colon should be resected because of the dangers of infection, hemorrhage and malignant degeneration. It is rarely possible to re-establish intestinal continuity without recurrence of symptoms.

6 The rectum must be removed in all cases with severe rectal ulceration, stricture, polyps, or anorectal fistulas.

7 At the present time a permanent ileostomy must be accepted as the price of a good result. With the Koenig-Rutzen bag an ileostomy does not constitute a great disability.

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# CRANIOFACIAL MORPHOLOGY IN CLEFT PALATE AND CLEFT LIP DEFORMITIES

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MAN has a rather definite idea of just what he should look like. He is liberal enough to allow certain individual differences but the basic physiognomical pattern is set. A man may have a withered arm or a club foot but facial aberrations may prove a much greater handicap as the unfortunate individual tries to take his place in society. And when this critical attitude toward facial deformities is combined with the individual's own hypersensitive psychic response the problem becomes even more complex. In congenital defects such as cleft palate and cleft lip the surgeon starts with an abnormal pattern of obscure etiology, unknown growth and development and questionable prognosis. Surgical management labors under a further handicap because in spite of the fact that therapy is instituted quite early any appraisal of the results must await nature's fullest contribution conferred by maturity. Despite refinement of surgical techniques a number of provocative questions must be answered before any definite criteria for success and failure can be established. Why do we see such wide variations in facial appearance among the cleft palate group? Are the ultimate results different for different surgical techniques and timing? Can fibrous bands of scar tissue resulting from soft tissue repair hold back growth and development? What is the developmental pattern in patients operated upon versus that in those not operated upon? These questions are the basis of the following report of a continuing study in which we have attempted to determine the differences that exist between this particular congenital deformity and the normal pattern.

Embryological study reveals clearly what happens (Fig. 1). Cleft lip results from the failure of union of the maxillary and median nasal processes. According to Sicher, tenuous

epithelial union does take place at one stage but because it is not replaced with mesodermal tissue it later gives way. Cleft palate results from a lack of fusion of the palatal processes with one another and with the nasal septum. The obscure etiology has given rise to a host of theories on the nature of cleft palate. Brophy and Logan were of the opinion that the maxilla was much broader in cleft palate patients than in normal ones and that the cleft was the result of failure of union of well developed parts (12) necessitating early osteotomies to prevent atrophy of the soft tissue and spreading of the cleft by action of the tongue and pressure of the mandible against the inclined planes of the alveoli. Others (2, 3, 4, 13, 23) have felt that there is an inherent lack of tissue and have relied on such operations as the modified Dorrance pushback techniques attempting closure by soft tissue only. Of considerable interest to the followers of either philosophy is the timetable of maxillary growth to serve as a basis for operative timing. Todd and Brash have both shown from large samplings of skeletal material that approximately five sixths of the total palatal breadth have been accomplished by the end of the 4th year in normal individuals with total width increments by the end of the 10th year (5, 28).

The present analysis of the developmental patterns and facial morphology in cleft palate is part of a serial or longitudinal survey and critical appraisal of the developing aberration. All patients are being followed and examined at regular intervals. The subjects for this investigation were 45 cleft palate patients ranging in age from 7 months to 58 years, selected at random but with some effort to include patients not operated upon as well as those operated upon. Deformities varied from simple alveolar cleft to complete bilateral lip and palate clefts. Table I shows the varying types. The method of study was primarily roentgen

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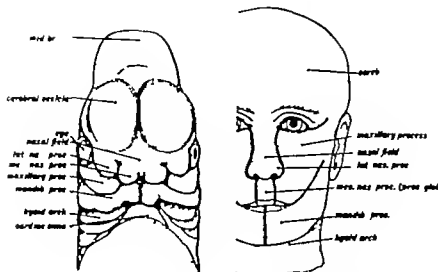


Fig. 1. Embryonic processes contributing to facial development and their adult derivatives.

ographic The Broadbent Bolton cephalometer (6) was used as a means of accurately positioning the patient's head to the film and x ray tubes (Figs. 2, 3, 4). Plaster casts, photographs, and a series of five head plates were taken of each patient, and case histories were compiled. Three lateral plates, wide open mouth physiologic rest and occlusion and two anteroposterior plates positions of physiologic rest and occlusion were taken—on about 225 views in all. The following anthropometric landmarks and measurepoints seen in Figure 5 were used:

1. Nasion. The frontonasal suture or junction of frontal and nasal bones.

2. Sella turcica. The center of the bony crypt occupied by the hypophysis cerebri. Roentgenographically a very constant profile outline seen in its lateral aspect.

3. Porion. This is a machine registration of the center of the external auditory meatus not necessarily corresponding to the anthropometric landmark in the skull proper but nevertheless constant.

4. Orbitale. The lowest point on the inferior bony margin of the orbit, usually as viewed in the lateral plate.

5. Gnathion. The most outward and everted point on the profile curvature of the symphysis of the mandible.

6. Gonion. The most outward and everted point on the angle formed by the junction of the ramus and body of the mandible on its posterior inferior aspect.

7. Anterior nasal spine. The spinous process of the maxilla forming the most anterior projection of the floor of the nasal cavity.

8. Pterygomaxillary fissure. An oval looped radiolucency resulting from the fissure left by the pterygoid process of the sphenoid bone and the most posterior portion of the maxilla.

9. Pogonion. The most anterior point on the symphysis of the mandible.

10. Point A. An arbitrary [measure] point, taken at the innermost curvature from anterior nasal spine to the crest of the maxillary alveolar process, signifying the approximate juncture of the basal or supporting maxillary bone and the alveolar bone.

Since the introduction of the Broadbent Bolton cephalometer in 1931 numerous studies have been made on growth and development of children, normal and abnormal. Of special interest are the works of Brodie and his co-workers (9, 10, 11), Broadbent (7, 8), Herzberg and Hollic, Mayne, Brash Thompson, Toothaker, Baldrige, and Downs. These to-

TABLE I.—FREQUENCY OF TYPES OF CLEFTS

Type	Male	Female	Total	Percent age
Right unilateral lip-jaw-palate			8	
Left unilateral lip-jaw-palate	5	6		
Complete bilateral lip-jaw-palate		5		
Soft palate without alveolar cleft				
Alveolar cleft				
Soft palate and soft palate				

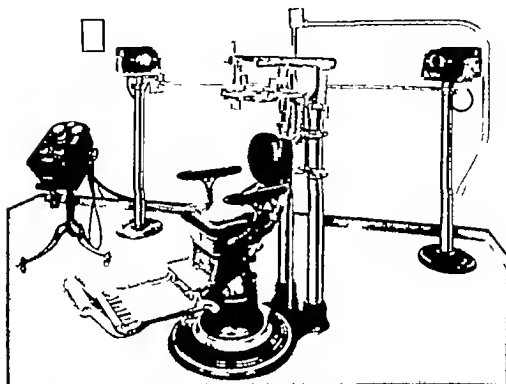


Fig 2. Broadbent Bolton cephalometer used for positioning patients for lateral and frontal cephalometric roentgenograms. There is a constant target film distance of 5 feet which confers reasonably parallel rays eliminating objectionable distortion.

gether with studies made on skeletal material (16-19 21 22 29) form a basis of comparison in any study of congenital or environmental

deformities. Certain criteria for determining facial characteristics have been set up based on those used by other investigators in studies

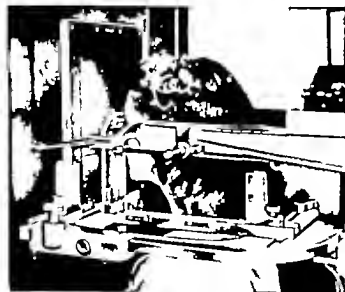


Fig 3. Lateral view of patient in position for a frontal roentgenogram.



Fig 4. Film cassette inserted for a lateral roentgenogram.

TABLE II.—NORMAL CRITERIA FOR DETERMINING CRANIOFACIAL DEVELOPMENT

Criteria	Investigator	Mean	Range	S D	Material
Nasal height	Brash	43.3% (infants)			Skele
		43.8% (adults)			
	Brodie	3%			Normal children
	Herzberg and Holic	43.31%	3.4%	$\pm 1.4^{\circ}$	Skele
Maxillary height	Mayne	43.05%	30.7-40.3	$\pm .40^{\circ}$	30 adults
	Mayne	41.04%	37.8-30	$\pm .08^{\circ}$	30 adults
Intermaxillary clearance	Thompson	2-2.5mm			
Mandibular plane to Frankfurt plane	Downs	0°	7-18°		40 adults
	Mayne	0°	3-10°	$\pm .07^{\circ}$	30 adults
Angle of lower incisor to go-ga plane	Speidel	92.4°	78-100°	$\pm 6.0^{\circ}$	
	Maryabin	90°			
	Downs	3°	1-9-17°	$\pm 3^{\circ}$	40 normal
	Toothaker	64.95°	3-100°		30 adults
Mandible with upper first molar angle	Brodie	67.34°		$\pm .36$	
	Mayne	64.85°	50-75°	$\pm .50$	30 adults, children
	Baldridge	67.45° (Class I)		$\pm .37^{\circ}$	
		64.40° (Class II)		$\pm 3.5^{\circ}$	
		67.80 (Class II, Dev )			
Mandible with gonion angle	Mayne Baldridge	67.95°	50-77	$\pm .85^{\circ}$	30 adults, children
		66.54° (Class I)		$\pm 3.62^{\circ}$	
		66.60° (Class II)		$\pm .82^{\circ}$	
		66.80° (Class II, Dev )			
8 Sella nasion-gonion angle	Mayne	79.90°	3-87°	$\pm 3.28^{\circ}$	30 adults
Nasion sella gonion angle	Mayne	57°	3-110.5°	$\pm 3.34^{\circ}$	30 adults
Facial angle	Downs	87.7°	82-95°		40 normal
	Mayne	87.87°	78-94	$\pm 3.10^{\circ}$	30 adults
Angle of convexity	Downs	$\pm 0^{\circ}$	-8 to + 0°		30 adults

of normals. Figure 5 shows the planes and landmarks used. Table II the selected normals for these criteria.

1 *Face height (Nasion-gonion)* The works of Brodie, Brash, Herzberg and Holic, Thompson and Mayne have established a constant ratio of about 43 per cent for nasal height or upper face height and 57 per cent for lower face height. This ratio seems constant from infancy and appears to be unaffected by most environmental influences. In this study face height was further broken down into the com-

ponents of the lower face—of prime concern because the insult has occurred in this area. Mayne found that maxillary height in 30 adults with normal dentitions averaged 41.66 per cent.

2 *Intermaxillary clearance or freeway space* This is the amount of space between the upper and lower teeth with the mandible in physiological rest position—a remarkably constant relationship established by facial masticatory and skeletal musculature when the mandible is not in active function. Thompson has found

this to average 2 to 3 millimeters in the anterior region in normal occlusion. Presence or absence of teeth does not affect this position.

3 *Frankfort mandibular plane angle* The angle formed by a line tangent to the lower border of the mandible extended posteriorly till it crosses the Frankfort horizontal plane (porion-orbitale) has been considered of significance in evaluating mandibular development especially ramus height. In his study on normals Downs arrived at a mean value of 21.9 degrees. Mayne used a line adjoining the anthropometric landmarks gonion and gnathion instead of a tangent and established a mean angle of 22.61 degrees.

4 *Angulation of mandibular incisors* This angle has been studied by numerous investigators following the emphasis placed upon it by Tweed as a clinical criterion in orthodontic case analysis and prognosis (31). All men have found the angle to be approximately 90 degrees.

5 *Nasion sella turcica mesiobuccal cusp of upper first molar* A rather constant angle of about 67 degrees is found in studies on normals. Specifically, any greater value would establish the molar in a posterior position while closing of the angle means a forward positioning of the molar or maxilla itself. In normal jaws the upper first molar falls almost exactly on a line from the sella turcica to the anthropometric landmark gnathion—or chin point—on the mandible.

6 *Facial angle* The lower internal angle formed by the juncture of the Frankfort horizontal plane with a line from nasion to pogonion (or gnathion) gives a mean value of 87.7 degrees. This measurement determines the relative position of the chin point and thus anteroposterior growth of the mandible when compared to a constant plane—Frankfort horizontal. The same information can be got from the angle sella turcica nasion-gnathion using the S-A plane as a base plane instead of the Frankfort horizontal. The angular values are different naturally but both are constant. The determined mean for the latter is about 80 degrees.

7 *Angle of convexity (nasion point A pogonion)* This is another means of evaluating the position of the maxilla with respect to the

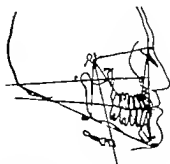


Fig. 5 Cephalometric and anthropometric landmarks and planes used in this study.

rest of the face and cranium. The angle formed by the lines joining these three measurepoints shows the degree of concavity or convexity of the profile. Downs found the mean value was  $\pm 0$  degrees. A minus reading indicates either a deficient maxillary contribution anteroposteriorly or an excessive mandibular accretion. It would then be necessary to examine other angular measurements of both maxilla and mandible to arrive at a differential diagnosis. A minus reading indicates a concave profile and a plus reading indicates a convex profile.

Each of the above criteria was carried through for all cases and the mean range standard deviation and standard error determined. These records are on file in the Orthodontic Department of Northwestern University. For this report, a master chart has been compiled giving the mean and range for each criterion as it compares to values arrived at in normals (Table III).

Face height was considered in order to see if there was any noticeable difference between cleft palate and normal cases. There is a broad range in upper face height with an excessive percentage contribution of upper face height. This does not necessarily mean that nasal height is greater but rather a lesser contribution of a component of the lower face. This seems to be the case as maxillary height is graphically deficient. All measurements here as well as in other criteria have been taken with the dental arches in occlusion with one exception. That exception is the amount of intermaxillary clearance at physiologic rest. All normal studies have been made with teeth in occlusion only. However a separate series of percentages and angular values have been determined in the cleft palate group with the



TABLE II—NORMAL CRITERIA FOR DETERMINING CRANIOFACIAL DEVELOPMENT

Criteria	Investigator	Mean	Range	S.D.	Material
Nasal height	Brash	41.5 <sup>mm</sup> (infants)			Skulls
		84 <sup>mm</sup> (adults)			
	Brodie	"			Normal children
	Herzberg and Holic	43.5 <sup>mm</sup>	14 <sup>mm</sup>	± 1.4 <sup>mm</sup>	Skulls
Mandibular length	Mayne	43.05 <sup>mm</sup>	39.7-40.5	± .40 <sup>mm</sup>	50 adults
	Mayne	66 <sup>mm</sup>	57.5-70	± .68 <sup>mm</sup>	50 adults
Intermaxillary clearance	Thompson	3-30 <sup>mm</sup>			
Mandibular plane to Frankfurt plane	Davies	9°	7-15°		50 adults
	Mayne	1°	5-36°	± .41°	50 adults
Angle of lower incisor to go-gon plane	Spardel	0.6°	76-106°	± 6.10°	
	Marxholm	00°			
	Davies	6.5°	6.5-97°	± 5°	50 normal
	Toothaker	0.4-0.4°	3-106°		50 adults
Nasion-sella upper first molar angle	Brash	07.50°		± .30°	
	Mayne	8.5°	50-5°	± 1.56°	50 adults, children
	Bakridze	07.04° (Class I)		± .8-°	
		09.40° (Class II)		± .5°	
Nasion-sella-gon (theta angle)	Miss M. Bakridze	07.45°	50.5-7.5	± .85°	50 adults, children
		08.50° (Class I)		± .85°	
		10.04° (Class II)		± .85°	
		08.30° (Class II, Dev.)			
Sella nasion-gon (theta angle)	Miss M.	70.90°	3-8.5°	± .58°	50 adults
Nasion-sella-pronion angle	Mayne	01.57°	09-110.5°	± 1.97°	50 adults
Facial angle	Davies	7°	02-45°		50 normal
	Mayne	8.37°	8-4.5°	± 1.37°	50 adults
Angle of convexity	Downs	± 0°	-8 to +40°		50 adults

of normals. Figure 5 shows the planes and landmarks used. Table II the selected normals for these criteria.

1 *Face height (Nasion-gonathion)* The works of Brodie, Brash, Herzberg and Holic, Thompson and Mayne have established a constant ratio of about 43 per cent for nasal height or upper face height and 57 per cent for lower face height. This ratio seems constant from infancy and appears to be unaffected by most environmental influences. In this study face height was further broken down into the com-

ponents of the lower face—of prime concern because the insult has occurred in this area. Mayne found that maxillary height in 50 adults with normal dentitions averaged 41.66 per cent.

2 *Intermaxillary clearance or freeway space* This is the amount of space between the upper and lower teeth with the mandible in physiological rest position, a remarkably constant relationship established by facial masticatory and skeletal musculature when the mandible is not in active function. Thompson has found



Fig. 6.



Fig. 7

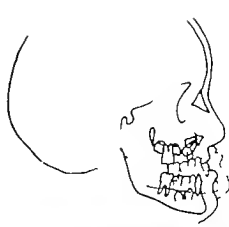


Fig. 8



Fig. 9.



Fig. 10



Fig. 11



Fig. 12



Fig. 13.

Fig. 6 Case D.Q., cleft palate, 6 years. Tracing of lateral cephalometric roentgenogram with an abnormally wide intermaxillary clearance (17 millimeters) Mandible in physiologic rest and occlusion

Fig. 7 Case D.Q. cleft palate, 7 years. Mandible in physiologic rest and occlusion. The intermaxillary clearance has increased 3 millimeters during the past year

Fig. 8 Case D.Q. cleft palate 8 years. Mandible in physiologic rest and occlusion. Overclosure of the mandible, with its forward thrust of the chinpoint exaggerating the maxillary deficiency. Intermaxillary clearance, 20 millimeters

termmaxillary clearance thus requiring the mandible to overclose in order to bring the teeth into occlusion. Thus constancy is shown in Figures 6, 7, and 8 where despite obvious maxillary deficiency the musculature has at

Fig. 9. Case L.G. plaster cast on left of a patient not operated upon for complete bilateral cleft (area outlined in pencil). Model on right, Case R.P. is that of a 13 year old boy who has had 15 operations for palatal closure

Fig. 10. Comparison of plaster cast of Case H.S., a 5 year old girl with a palate not operated upon, with that of Case R.P. of Figure 9

Fig. 11. Frontal views of Case R.P. and Case H.S.

Fig. 12. Case R.P. Relationship of maxilla and mandible.

Fig. 13. Case H.S. Normal relation of maxillary and mandibular dental arches.

tempted to maintain a normal facial balance and relation of parts. These three tracings of cephalometric roentgenograms of the same individual taken at intervals of 1 year show intermaxillary clearance values of 17, 19, and

TABLE III—CRANIOFACIAL MEASUREMENTS TAKEN WITH TEETH IN OCCLUSION

Present study			Normals		
Criteria	Mean	Range	Investigator	Mean	Range
Nasal height	1.2%	.16-.21%	Brash	41.2% (infants)	3.6%
				42.6% (adults)	
			Bruch	43.0%	
			Hartberg and Høbe	43.5%	
Maxillary height	14.2%	9-15.4%	Mayne	43.05%	39.1-46.2%
Intermaxillary clearance	7.2 mm	3-10 mm	Mayne	41.04%	37.9-45.4%
Mandibular plane to Frankfort plane—angle	84.1°	78-84	Thompson	7-3 mm	
			Downs	6°	37-48°
Angle of lower incisor to go-gn plane	70.6°	63-81°	Mayne	61°	52-70°
			Speidel	6.6°	78-90°
			Margolis	90.0°	
			Downs	6.5°	64.3-90°
Nasion-sella-upper first molar angle		63-70.5°	Trochaker	64.96°	72-90°
			Brodie	61.90°	
			Mayne	61.85°	59-75°
			Richbridge	67.05° (Class I)	
Nasion-sella-gonion angle	68.9°	58-77°		68.25° (Class II, Dev.)	
				67.80° (Class II, Dev.)	
			Mayne	67.85°	59.2-72.5°
			Richbridge	68.90° (Class I)	
Sella-sinion-gonion angle	80.0°	70-95°		70.50° (Class II)	
				68.80° (Class II, Dev.)	
Platyge-mandibular fissure to line S-X	2 mm	0-6 mm	Mayne	79.90°	7.3-85°
Nasion-sella-gonion angle	64	67-107	Mayne	10.37°	95-110.5°
Facial angle	83.5°	73-90°	Downs	87.7°	82-91
Angle of convexity	-8.5°	-30 to +6°	Downs	8.87°	-8.5 to +10°

mandible at physiologic rest but must await future similar studies on normals for a means of appraisal. It is of interest to note the similarity of physiological rest values in the cleft palate group to what might be considered a valid projection from normals with teeth in occlusion and allowing a normal intermaxillary clearance (Table IV).

The difference in the length of the line nasion gonathion in millimeters in physiolog-

ical rest and occlusion headplates determined the intermaxillary clearance. A very wide range can be noted and the mean of 7.3 millimeters is considerably more than the average values for normals. Apparently this substantiates the contention that the rest position is the result of muscular balance that it is extremely constant and subject to little change from birth to death. Maxillary or mandibular deficiency means a correspondingly greater in-



Fig 6



Fig 7



Fig 8



Fig 9.



Fig 10.



Fig 11



Fig 12.



Fig 13

Fig 6 Case D.Q. cleft palate, 6 years. Tracing of lateral cephalometric roentgenogram with an abnormally wide intermaxillary clearance (17 millimeters). Mandible in physiologic rest and occlusion.

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intermaxillary clearance thus requiring the mandible to overclose in order to bring the teeth into occlusion. This constancy is shown in Figures 6, 7, and 8 where despite obvious maxillary deficiency the musculature has at-

tempted to maintain a normal facial balance and relation of parts. These three tracings of cephalometric roentgenograms of the same individual taken at intervals of 1 year show intermaxillary clearance values of 17, 19,

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TABLE IV—CRANIOFACIAL MEASUREMENTS TAKEN AT PHYSIOLOGICAL REST COMPARED WITH NORMALS IN OCCLUSION

Present study			Normals		
Criteria	Mean	Range	Investigator	Mean	Range
Nasal height	41.7%	37.5-45.5"	Brink	41.3% (infants)	
				42.8% (adults)	
				43.0%	
			Harvort and Holst	43.5%	41%
			Mayne	43.95%	39.5-46.5"
Mandibular height	36.9%	30-45%	Mayne	41.60%	37.5-46.5"
Mandibular plane to Frankfort plane	13.8°	8.5-24.1°	Downs	11.6°	7-20°
			M. J. Lee	8.1°	3-20°
Nasion-sella-gnathion angle	69.05°	60.2-81.0°	M. J. Lee	67.05°	59.5-75.5°
			Baldridge	67.95° (Class I)	
				70.96° (Class II, Dev.)	
				67.84° (Class II, D)	
Sella-nasion-gonion angle	6.5°	7.0-0.15°	Mayne	70.96°	7.5-8.5°
8 Nasion-sella-gonion angle	03.5°	00-07.0°	Mayne	36.31°	00-10.5°
7 Facial angle	8.5°	7.0-9.0°	Downs	8.75°	5.5-10.5°
			M. J. Lee	8.75°	7.0-11.0°
8 Angle of convexity	-6.0°	-20 to -	Downs	± 0°	5 to +20°

20 millimeters at 6, 7, and 8 years, respectively.

The value for the Frankfort mandibular plane angle is well within the central part of the range established for normals. However, there is some suggestion of a possible tendency toward a mandibular underdevelopment. As yet there is no apparent explanation why a maxillary insult should be reflected in lack of ramus height of the mandible.

The value of 79.6 degrees for the angle formed by the lower incisor to the mandibular plane is well below the means established by any investigator on normals. Some investigators would point to an abnormally short and tight upper lip reflected through decussating fibers of the lower lip in constant contact with the dental units as the logical reason (15-25). The lingual tipping of the dental units helps to adjust the normally developed pattern of the mandible to the aberrant maxillary pattern thus reducing the apparent discrepancy.

The maxillary first molar shows a posterior positioning when compared to normal occlusions, with the angle nasion-sella-upper first molar becoming more obtuse. Further measurements involving the mandible (nasion-sella-gnathion, sella-nasion-gnathion, nasion-sella-gonion, and the facial angle) corroborate impressions gained from the Frankfort mandibular plane figures—namely that the mandible seems normal on the small side. The typically concave profile so often associated with cleft palate and cleft lip deformities is shown roentgenographically by a high negative angle of convexity of -8.2 degrees for the mean.

Table V is a comparison of the 8 cleft patients, not operated upon with the 14 complete cleft patients whose lips and palates have been surgically closed. The normal mean is included to facilitate evaluation. The mean values for maxillary height (item 2) and anteroposterior development (item 11) show an

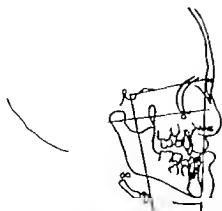


Fig. 14-

Fig. 14. Case R.P. Physiologic rest cephalometric tracing. 13 millimeter intermaxillary clearance nasion-gnathion, 112 millimeters.

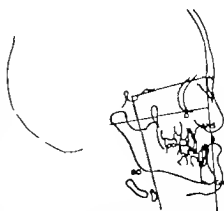


Fig. 15-

Fig. 15. Case R.P. Occlusion cephalometric tracing. Note combination of maxillary deficiency with mandibular overclosure nasion-gnathion, 100 millimeters.

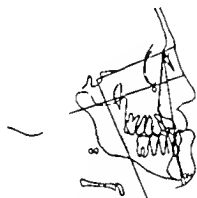


Fig. 16

Fig. 16. Cephalometric lateral tracing of a surgically repaired bilateral complete cleft case, M.A., aged 15 years. Orthodontic treatment has been completed. Maxillary incisors have been tipped markedly forward to compensate for maxillary underdevelopment.

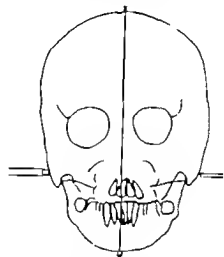


Fig. 7

Fig. 7. Frontal cephalometric tracing of Case M.A. rest position.

even greater deviation from the normal in the patients operated upon than did the average of 45 cases of all types (Table III). The same measurements in the group not operated upon approach the normal means and fall well within the normal ranges. While the intermaxillary clearance (item 3) seems to be slightly excessive in the group not operated upon—4 millimeters—this is just about half the average of 8.1 millimeters in the surgically closed complete cleft group. Lower incisor and upper first molar readings also show less deviation from the normal means in the series not operated upon as opposed to the group operated upon. Judging from measurements designed

to be applied to the mandible there still seems to be a tendency toward a slight underdevelopment in this bony unit regardless of therapy or lack of therapy (items 4, 7, 8, 9, 10). Figure 9 shows for comparison the maxillary cast of a complete bilateral cleft lip and palate which had received no surgical treatment and the cast of the same type of cleft from a 13 year old boy who has had 15 surgical operations to provide a rock hard functionless flat fibrous diaphragm that successfully separates the nasal and oral cavities. Figure 10 compares the cast of the latter with that of a 5 year old girl who also has had no surgical correction of the palatal cleft. Figure 11 is an

TABLE V — MEAN COMPARISON OF RESULTS IN PATIENTS WITH COMPLETE CLEFTS OPERATED UPON AND NOT OPERATED UPON\*

Criteria	Operated	Unoperated	Normals
Nasal height	7 1/2"	44 1/2%	43 05% (Mayne)
Mandibular height	27 7/8"	28 0/2"	66% (Mayne)
Intermaxillary clearance	8 mm	cm	2-3 mm (Thompson)
Angle of maxillary to Frankfurt plane	14 1/2°		9° (Downs)
Angle of lower incisor to maxillary plane	78 1/2°	80 1/2°	8° (Downs)
Maxilla with upper first molars	1°	70 1/2°	67 1/2° (Brodie)
Maxilla with postincisors	64 1/2°	69 0/2°	67 0/2° (Mayne)
4 Sella maxilla-postincisors	77 0/2°	77 1/2°	70 0/2° (Mayne)
Maxilla-sella-postincisors	52 0/2°	70 1/2°	70 1/2° (Mayne)
10 Facial angle	8 1/2°	8 1/2°	67 1/2° (Downs)
Angle of convexity	-9 1/2°	-0°	± 0° (Downs)

\*Mean values taken from cephalometric roentgenographic studies on normal groups by various investigators

anterior view of the same casts. Figures 12 and 13 show articulated maxillary and mandibular models and emphasize the anteroposterior malrelation of the patient operated upon when compared to the one not operated upon. Figures 14 and 15 are tracings of the patient operated upon taken at physiologic rest and occlusion again emphasizing the vertical and anteroposterior maxillary deficiency. The evidence afforded by these comparisons would seem convincing proof of the damaging effect which can follow operations in early life if tissues which should be free to expand and develop are confined and restricted in a rise of heavy unyielding suture material and subsequent scar tissue formation.

Nine of the present group had some degree of orthodontic therapy subsequent to surgical correction. Figures 16 and 17 show the cephalometric tracings in a patient with a result that would be considered a success clinically if casts were the only diagnostic aid. The upper and lower incisors are in normal mesiodistal relationship but there is a significantly high labial axial inclination of the maxillary incisors to bring them into normal interdigitation. This is combined with a large angle of profile concavity. Some observers would question the stability of this type of result where

lack of basal bone support reception of masticatory stress in an abnormal manner and constant pressure of a hypertonic upper lip make any hope of environmental balance a dubious one. It is quite likely in many cases that the tooth to basal bone relationship is more favorable before orthodontic treatment is undertaken and that instead of correcting malposed bony segments by moving bone itself (which can be done orthodontically) or ordinary orthodontic procedures move teeth through bones to a better occlusal relationship but a more unfavorable tooth to basal bone relationship.

#### SUMMARY

Certain salient impressions may be gained from this initial report.

1. The maxilla in cleft palate and cleft lip patients is deficient not only in its anteroposterior and lateral growth but also in its vertical growth. There is an abnormally large contribution of upper face height to total face height when the teeth are in occlusion due to the vertical maxillary deficiency. The high negative angle of convexity demonstrates specific lack of anteroposterior development.

2. There is a larger intermaxillary clearance or freeway space in cleft palate individuals. The variance from the normal becomes marked in complete cleft cases that have been corrected surgically. This would suggest that while there is a bony insufficiency, the general musculature, with the exception of those involved in surgical operations, attempts to maintain a normal developmental pattern and relation of parts.

3. Mandibular growth on the whole appears normal. Some lack of development is noted, but in any series of 45 individuals, a certain percentage will be found with similar problems. Mandibular underdevelopment is actually advantageous in some cases, reducing the disharmony resulting from a maxillary growth insult and thus improving facial balance. Mandibular overclosure, allowed by an excessive intermaxillary clearance is a consequence of the maxillary deficiency.

4. There is an excessive lingual axial inclination of the lower incisors to the mandibular plane. It need not be called teleological reasoning to look on a hypertonic orbicularis oris

muscle complex as a possible explanation. Any tightness of the upper lip is reflected through decussating fibers to the lower lip in constant contact with the dental units. The lingual positioning of the mandibular incisors reduces the underjet or the extent the maxillary incisors are abnormally posterior to the lower anterior segment, and hence should not be used as a criterion of maxillary development.

5 The maxillary first molar tends toward a posterior position with reference to cranio-metric measurepoints outside the maxilla.

6 We have seriously considered the propriety of early closure of cleft palates. *It is becoming apparent that surgical correction will in some instances limit the growth potential of the maxillary denture (4/5ths of which are accomplished laterally by the end of the 4th year)* In general the greater the number of operations the more marked the deviation from the normal. The apparently normal lateral and vertical growth in patients not operated upon where no limiting band of scar tissue is present would seem to substantiate this deduction.

7 The clinical results of orthodontic treatment while improving the tooth relationship in many cases do not necessarily stimulate basal bone development. Therapeutic results that are unstable have to be maintained in definitely

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# THE STABILITY OF AC GLOBULIN AND OF PROTHROMBIN IN CITRATED HUMAN PLASMA

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WITH the widespread use of stored blood a knowledge of the stability of the various plasma components concerned in the clotting mechanism has assumed increased value. Numerous investigators have reported studies on the change in plasma prothrombin during storage, but have arrived at somewhat contradictory conclusions (1 2 3 7 8 9 12 18). No reports have appeared on the stability of Ac-globulin a plasma globulin which accelerates the change of prothrombin to thrombin. The concentration of this substance in plasma like prothrombin is less than 0.5 per cent of the total plasma proteins (15). Ac-globulin is probably the same substance as factor V described by Owen (6) which was found to be absent from the blood of a certain patient with a bleeding diathesis which was not hemophilia (4 5). The absence of this factor from highly purified prothrombin preparations accounts for the slow rate at which these preparations are changed to thrombin even in the presence of optimum amounts of thromboplastin and calcium ions (16).

In a study of the exact role of Ac-globulin in blood clotting Ware Murphy and Seegers (14) came to the following conclusions: (a) Ac-globulin is inactive in circulating plasma under normal conditions. (b) At the inception of clotting Ac-globulin is first partially activated by extremely small amounts of thrombin formed from the interaction of prothrombin thromboplastin, and calcium. (c) The presence of small amounts of active Ac-globulin then catalyzes the interaction of prothrombin thromboplastin, and calcium. (d) The increased thrombin concentration further catalyzes the activation of Ac-globulin and the process proceeds co-autocatalytically to com-

plete the prothrombin activation process. The inactive form of Ac-globulin, present in the circulating plasma, is called "plasma Ac-globulin" by these investigators and the active form is called serum Ac-globulin. In order to include Ac-globulin the generally accepted theory of blood clotting has been modified to the following form:

Prothrombin + Thromboplastin  $\xrightarrow{\text{Ca}^{++}}$  Thrombin (Slow)

Plasma Ac-globulin  $\xrightarrow{\text{Thrombin}}$  Serum Ac-globulin

Prothrombin + Thromboplastin  $\xrightarrow{\text{Ca}^{++}}$  Thrombin (Rapid)  
Serum Ac-globulin

Fibrinogen  $\xrightarrow{\text{Thrombin}}$  Fibrin (Clot)

Because Ac-globulin is fundamentally concerned with the activation of prothrombin it is important to learn how the concentrations of both of these substances are changed during storage.

## PROCEDURE

Blood was obtained by venipuncture from normal adult human subjects. The first few cubic centimeters were discarded in order to reduce the possibility of contamination by tissue fluids, and the experimental sample was collected in a second syringe from the same needle. Two parts of 3.2 per cent sodium citrate solution contained in the syringe was used as anticoagulant for 23 parts of whole blood giving a final citrate concentration of 0.0087 M. After centrifugation at 2,000 revolutions per minute for 15 minutes at room temperature, the plasma was placed in a stoppered test tube in a refrigerator at 3 to 5 degrees C., and analyzed at intervals as indicated in Figures 1 and 2.

The prothrombin concentration was determined by the two stage method of analysis (11 17) and by a modification of this method

From the Department of Physiology Wayne University College of Medicine, and aided by grant from the United States Public Health Service, National Institute of Health.

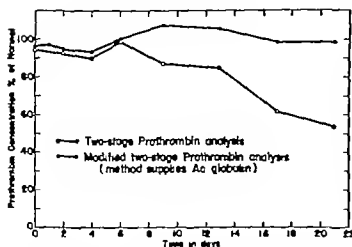


Fig. 1. Change with storage time in the prothrombin concentration of citrated human plasma as measured by two stage method of analysis and by a modification of method.

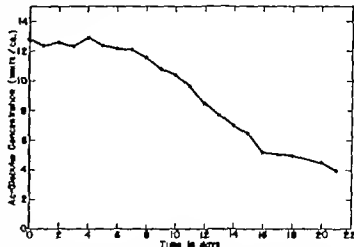


Fig. 2. Change with storage in the mean Ac-globulin concentration of 5 samples of stored citrated human plasma.

(10) in which an optimum amount of accelerator factor is especially provided in the first stage of the determination. This special maneuver of supplying Ac-globulin becomes important in the two stage analysis when prothrombin is not already associated with an abundant supply of accelerator (6, 13, 14). In the original two stage method prothrombin is activated by the action of excess thromboplastin calcium and any Ac-globulin which happens to be present in the analytical sample. In the modified two stage method the supply of Ac-globulin is not left to chance. It is supplied in the form of bovine serum diluted 1:600. This amount assures a quantitative change of prothrombin to thrombin (10).

The method used for the determination of Ac-globulin employs the same reagents used for prothrombin analysis. In the actual determination a standardized solution of purified prothrombin is needed. Since it does not become activated by the two stage prothrombin reagents but does if Ac-globulin is added the rate of thrombin formation is a quantitative measure of Ac-globulin activity. Details of the test are described by Ware and Seegers (15, 16).

#### RESULTS

In 6 different experiments the prothrombin level of plasma as determined by the unmodified method of analysis remained constant for a period of about 7 days then decreased progressively to about 50 per cent of the original level at 21 days. A representative experiment

is presented in Figure 1. The prothrombin level determined by the modified method remained constant for the entire period of 21 days. In 5 different experiments mean values of which are shown on Figure 2 the plasma Ac-globulin remained constant for 7 days and then decreased to about a third of the original level after 21 days.

In several other experiments the prothrombin level was found by the modified method to remain unchanged for a period of 56 days.

In order to obtain information on whole blood a study was made of the stability of prothrombin and Ac-globulin by the same methods as previously described except that the blood was placed immediately in the refrigerator after mixing with the sodium citrate and without centrifugation. Plasma samples were removed for analysis from the supernatant plasma after the cellular elements had settled. Results similar to those obtained with citrated plasma were found for a period of 2 weeks for the stability of prothrombin in citrated whole blood. Ac-globulin was found to be somewhat less stable than in the centrifuged plasma. The decrease in activity began in less than a week. Studies with whole blood were not made beyond 2 weeks.

#### DISCUSSION

The apparent decrease in prothrombin level obtained with the original two stage method approximates the decrease in plasma Ac-globulin activity and appears to be attributable

to the interference of an Ac-globulin lack in the quantitative prothrombin determination. This deficiency is corrected in the modified two stage analysis for prothrombin.

Since the 2 factors, prothrombin and Ac globulin were reasured by methods which are considered specific and quantitative it follows that this study does not give information as to whether other clotting factors are altered. Reports in the literature (3, 7, 8, 9) show greater changes in stored plasmas. If those changes were due to prothrombin or Ac globulin there must have been a significant difference in the conditions of storage or the changes which those reports detected were concerned with fibrinogen or unrecognized clotting factors or both.

Stored blood as customarily used in hospitals, can then be considered as having full prothrombin content. A moderate diminution of Ac-globulin activity occurs on storage of blood. The nature of this decrease is such that it need not be a matter of concern in the ordinary use of the blood bank.

#### SUMMARY

The prothrombin content of plasma obtained from blood which contains 0.0087 M sodium citrate as anticoagulant remains constant for at least 21 days when stored at 5 degrees C. The level of Ac-globulin under the same conditions, remains constant for a week, decreases to about 55 per cent of the initial level in 2 weeks and to about 30 per cent in

3 weeks. The presence of formed elements has no effect on the stability of prothrombin. Ac globulin appears to be somewhat less stable in whole blood than in centrifuged plasma.

For reliable estimation of prothrombin by the two stage method it is necessary to supply Ac-globulin if a sufficient quantity is not already associated with the prothrombin sample.

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## PULMONARY EMBOLISM

### Its Incidence, Significance, and Relation to Antecedent Vein Disease

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**D**ESPITE the recent welter of literature on the subjects of thrombosis and embolism, many aspects of the problem are still clouded by confusion and doubt. Numerous prophylactic and therapeutic measures have been promulgated the respective values of and indications for which are by no means agreed upon. Much of the data concerning this problem are based on clinical diagnoses which unfortunately, are subject to a wide margin of error. Any factual data which bear on this subject should be of value in dispelling the vagueness and confusion which still prevail.

In search for such information we have reviewed the pulmonary emboli observed in a large series of consecutive and unselected postmortem examinations performed over a 17 year period. Our study embraces the necropsy material of the departments of pathology of Michael Reese and Chicago Memorial Hospitals during the years 1930 to 1946 inclusive consisting of 538 consecutive examinations. These two hospitals which are served by a common department of pathology have a total capacity of 800 beds. All cases in which pulmonary emboli were found, irrespective of their size or significance were carefully studied from both the anatomical and clinical records. The information elicited throws light on the incidence and significance of pulmonary embolism and its relation to antecedent vein disease and supports the indications for various prophylactic and therapeutic measures.

During the years covered in this study there was a total of 9980 deaths in the 2 hospitals. Autopsy was done in 538 of these cases an over all incidence of 56 per cent postmortem examinations by permission. In view of the

relatively large series and the long period covered it was our opinion that statistics drawn from the 56 per cent of the fatalities which came to autopsy could be projected with a reasonably small margin of error to the remaining 44 per cent which did not. This projection would permit an estimate of the total number of emboli occurring in all the fatal cases. We recognize that there are two potential sources of error in such an estimate: (1) It is possible that the families might be more reluctant to give permission for autopsy following sudden and unexpected deaths as from pulmonary embolism and that therefore the relative incidence of major embolism might be higher in the cases not having had autopsy. We know of no way of determining the validity of this criticism, but do not believe that it introduces a serious element of error. (2) More important is the fact that deaths resulting from trauma become coroner's cases and are not available for routine postmortem examination. This eliminates from our statistics those emboli which complicate fractures. This is a serious omission. However, despite these defects we believe our data to be more factual than are those based on clinical diagnosis alone.

In reviewing our data, it became immediately evident that it was necessary to divide the pulmonary emboli into several categories according to their significance. They fell rather readily into three fairly distinct classes. The largest group included those small emboli with or without pulmonary infarction which were purely incidental findings and which played no part whatever in the causation of the death of the patient. These were for the most part minute emboli often derived from mural thrombi in the cardiac chambers in persons who died of heart disease, pneumonias, cancer or other general causes. From the analysis of both the anatomical and the

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bland thromboses and thrombophlebitis is somewhat tenuous. Most vein inflammations are accompanied by regional thrombosis and even the blandest thrombi provoke some degree of reactive inflammation of the adjacent vein wall. Nevertheless vein diseases fall quite generally into the three fairly definite types.

The most severe form of vein disease is the suppurative type of thrombophlebitis. These arise within or contiguous to areas of suppuration and the clinical picture is dominated by the manifestations of sepsis rather than by evidences of venous obstruction. Typical examples of suppurative thrombophlebitis are seen in lateral sinus thrombosis, secondary to mastoid suppuration in pyelophlebitis from purulent appendicitis and in the involvement of the perimetrial venous plexus in septic abortions or deliveries. Suppurative thrombi are not associated with major embolism but showers of small emboli from the liquefaction of the thrombus may give rise to multiple small mycotic infarcts and consequent pyemic abscesses.

The intermediate form of vein disease is the nonsuppurative thrombophlebitis. This condition is best typified by the familiar puerperal "milk leg." It is usually characterized by an abrupt onset often with chill and a rapid rise in temperature. There is very severe pain in the lower extremity and a rapidly developing generalized edema producing the picture of the tense white swollen shin leg. With this prototype in mind it is not difficult to differentiate the thrombophlebitic from the bland or phlebothrombotic type of venous occlusion. This last named disease has long been considered to be silent and asymptomatic. So emphatically have the younger physicians been impressed with the absence of clinical manifestations of thrombosis that when they do encounter the disease and find manifest evidence thereof they are inclined to question the diagnosis and suspect the existence of a thrombophlebitis.

It has long been recognized that these two vein diseases differ greatly in their tendency toward embolus formation. In thrombophlebitis the thrombus is fixed to the vein wall by an inflammatory reaction which is often of

such magnitude as to produce an extensive perivascular tumefaction. Not only is the clot adherent to the vein wall but the vein itself is baked to the surrounding tissues. Such thrombi have very little tendency to break loose and form emboli. However it must be remembered that appended to the inflamed thrombus there may be a propagating soft red thrombus which is not firmly attached to the vessel wall and which like any other bland thrombus may be the source of a major pulmonary embolus. In contrast to the inflamed thrombus described, the bland thrombus lies loosely within the vein lumen and often incompletely occludes it. Such thrombi are easily dislodged and readily form the source of emboli to the pulmonary vessels.

#### RESULTS

As has been stated a total of 5388 autopsies were done in 9980 deaths giving an over all postmortem percentage of 56 per cent. Pulmonary emboli of some degree were found in 345 of the 5388 autopsies an incidence of 6.4 per cent. It must be mentioned that ours is a general hospital population which includes a pediatric division. Approximately 40 per cent of the autopsies in our series were in children under the age of 15 in whom the incidence of pulmonary embolism is very low. This would tend to make our percentage of total pulmonary emboli lower than it would be if only adult autopsies were included. This does not however affect the actual number of emboli encountered which is of course the important consideration.

A breakdown of these emboli according to their significance and the type of vein disease from which they arose follows. Of the total of 345 cases of pulmonary embolism 166 were classed as purely incidental findings. These consisted as has been stated of very small emboli with or without infarction which played no part whatever in the cause of death of the patient. Of this group 154 emboli originated in bland thrombi and only 12 from infective phlebitides. Eleven of the latter number were of the suppurative type and constituted numerous minute infected emboli which were part of a general pyemic picture. Only one embolus in this incidental group

clinical findings, it was concluded that their role was purely incidental so far as the death of the patient was concerned, and they were included in the category designated as "incidental emboli."

A second group intermediate in size, comprised the emboli of a larger grade with perhaps larger infarctions, in which there was adequate explanation for the patient's death aside from the pulmonary embolism but in which it was conceivable that the embolus might have been a factor in weighing the balance against the possibilities of survival from a failing heart, an extensive pneumonia, a general infection or some debilitating disease. The designation contributory emboli has been applied to this group.

The third category were the fatal emboli in which it was believed that the death was due directly to the embolus.

It must be obvious that in an arbitrary classification such as this, there are certain borderline cases in which there may be question as to whether a small embolus might be entirely incidental and may not have contributed in some measure to the lethal outcome. At the other end of the scale also there may be an occasional case in which it might be difficult to state that the embolus was merely a contributory and not the chief factor in the death of the patient. Nevertheless in the overwhelming majority of cases reviewed the differentiation into the three categories afforded no difficulty whatsoever.

The criticism will probably be raised that the exact role of the embolus in the cause of death cannot be measured with any degree of accuracy and that, therefore this classification of emboli is not justified. We recognize of course, that size alone is not the only significant characteristic of the pulmonary embolus that relatively small emboli may produce severe circulatory disturbances, and even death by evoking spasm of the remainder of the pulmonary vessels, and possibly by reflex vagal disturbances as described by De Takats and his associates. Also in persons with failing circulation it is impossible to state just how much additional embarrassment from a pulmonary embolism or infarct would be required to weigh the balance against re-

covery. However it must be emphasized that we have studied the clinical as well as the autopsy records, and have considered the general condition of the patient, the nature and severity of the underlying disease, and the mode of death in arriving at our classification. Some element of personal equation in evaluating the data cannot be eliminated. Nevertheless we are convinced that gross error and misleading conclusions are inevitable if all emboli are lumped together without regard to their size and to the total clinical and pathological picture and that a division such as we have made, arbitrary though it may be, is essential if pulmonary embolism is to be placed in its proper perspective and if prophylactic and therapeutic measures are to be logically evaluated.

From a practical point of view the cases in the first two categories are those in which because of the gravity of the underlying disease, prophylactic ligations could not or would not have been done. In estimating the lives which might have been salvaged had this or the other measure been instituted, these could not be included. A somewhat similar division was made by Crutcher and Daniel in the material from Vanderbilt University Hospital with results comparable to ours. In this series of 2580 autopsies, 55 massive pulmonary emboli were found. Of these, 21 could not have recovered from their disease even though the embolism had not occurred.

In addition to the incidence and significance of the emboli we were greatly concerned with determining the relationship of the embolus to the antecedent vascular disease which gave rise to the embolus. It has long been recognized that vein inflammations and thromboses also fall into three fairly distinct categories, each of which carries a different degree of hazard of pulmonary embolism. In an earlier publication (6) we characterized these diseases as bland thromboses, nonsuppurative thrombophlebitides, and suppurative inflammations of the veins. Ochsner has subsequently given the name phlebothrombosis to the group of so called bland thromboses, and this designation has been generally accepted in the more recent literature. It must be recognized that the differentiation between

bland thromboses and thrombophlebitis is somewhat tenuous. Most vein inflammations are accompanied by regional thrombosis, and even the blandest thrombi provoke some degree of reactive inflammation of the adjacent vein wall. Nevertheless, vein diseases fall quite generally into the three fairly definite types.

The most severe form of vein disease is the suppurative type of thrombophlebitis. These arise within or contiguous to areas of suppuration and the clinical picture is dominated by the manifestations of sepsis rather than by evidences of venous obstruction. Typical examples of suppurative thrombophlebitis are seen in lateral sinus thrombosis, secondary to mastoid suppuration, in pyelephlebitis from purulent appendicitis and in the involvement of the perimetrial venous plexus in septic abortions or deliveries. Suppurative thrombi are not associated with major embolism but showers of small emboli from the liquefaction of the thrombus may give rise to multiple small mycotic infarcts and consequent pyemic abscesses.

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#### RESULTS

As has been stated, a total of 558 autopsies were done in 9980 deaths giving an over all postmortem percentage of 56 per cent. Pulmonary emboli of some degree were found in 345 of the 558 autopsies an incidence of 61 per cent. It must be mentioned that ours is a general hospital population, which includes a pediatric division. Approximately 40 per cent of the autopsies in our series were in children under the age of 15 in whom the incidence of pulmonary embolism is very low. This would tend to make our percentage of total pulmonary emboli lower than it would be if only adult autopsies were included. This does not, however, affect the actual number of emboli encountered which is, of course, the important consideration.

A breakdown of these emboli according to their significance and the type of vein disease from which they arose follows. Of the total of 345 cases of pulmonary embolism 166 were classed as purely incidental findings. These consisted as has been stated of very small emboli with or without infarction, which played no part whatever in the cause of death of the patient. Of this group 154 emboli originated in bland thrombi and only 12 from infective phlebitides. Eleven of the latter number were of the suppurative type, and constituted numerous minute infected emboli which were part of a general pyemic picture. Only one embolus in this 'incidental' group



TABLE I—SOURCE OF PULMONARY EMBOLISM

<i>In incidental group</i>	
Not found	34
Heart	65
Leg veins	34
Inferior vena cava	1
Cerebral veins	1
Renal veins	1
Prostatic and ovarian veins	10
	166
<i>In contributory group</i>	
Not found	15
Heart	33
Leg veins	40
Inferior vena cava	7
Prostatic and ovarian veins	12
Renal veins	4
	131
<i>In fatal group</i>	
Not found	8
Leg veins	44
Inferior vena cava	1
Prostatic and ovarian veins	1
Renal veins	1
	56

was thought to have arisen from a nonsuppurative thrombophlebitis.

Contributory emboli that is, emboli of a somewhat larger size, with or without infarction which may have contributed to a degree in the death of the patient occurred in 123 cases. Of these, 108 arose from bland thrombi 5 from nonsuppurative thrombophlebitis and 10 from suppurative phlebitis. In the last mentioned group the pyemic abscesses in the lungs which were of embolic origin were considered to have contributed toward the septic death of the patient.

Massive primary or fatal emboli were found in 56 cases in this series, an incidence of 10 per cent of all the autopsies. Fifty-three of these fatal emboli resulted from bland thrombi while 3 occurred in patients with nonsuppurative thrombophlebitis and none in instances of suppurative vein disease.

The source of the emboli as nearly as could be determined at autopsy is tabulated in Table I. It will be seen that in the incidental group of those in which a source was mentioned the most frequent site of origin was from the cardiac chambers themselves. They were thought to have broken loose from small mural thrombi in the auricular appendages in patients with cardiac decompensation or auricu-

TABLE II—DISTRIBUTION OF EMBOLI IN MEDICAL AND SURGICAL CONDITIONS

	Phlebotrombotic emboli	Thrombophlebotic emboli	Total
<i>Incidental</i>			
Medical	106		106
Surgical	43		43
<i>Contributory</i>			
Medical	7	8	15
Surgical	36	7	43
<i>Fatal</i>			
Medical	1		1
Surgical	40	3	43
Total	181	11	192

lar fibrillation or from the ventricular walls at the sites of myocardial infarction. The presence of such mural endocardial thrombi does not rule out of course, the possibility of coexistent but unobserved thrombi in the veins of the lower extremities from which these small emboli may have derived their source. The leg veins were recognized as the second most frequent site of origin of the emboli in this group.

In the group of contributory emboli while the heart was still the source of a relatively large number of emboli the most frequent site of origin was the veins of the lower extremities. In the group of fatal emboli, almost all of the emboli arose from the veins of the lower extremities. The increasing frequency with which thrombi in the veins of the lower extremities constitute the source of embolism in the successively more serious groups of cases, is an expression of the role of size in the significance of pulmonary embolism. Large emboli must necessarily come from large vessels, and their bulk requires either great length or thick caliber. These conditions prevail particularly in the deep veins of the lower extremities. Massive emboli from other regions are extremely uncommon.

The various groups of pulmonary emboli covered in this study are further broken down in Table II according to whether they occurred in medical or surgical conditions. It will be seen that the smallest and least important emboli occurred almost twice as frequently in patients suffering from medical conditions as compared with those with surgi-

TABLE III.—INCIDENCE OF FATAL EMBOLI AFTER OPERATION

Total number of deaths	9,980
Percentage of permission postmortem examinations	56
Total number of fatal emboli found	56
Estimated total number of fatal emboli in all cases	100
Percentage of fatal emboli found at autopsy	1.07
Number of major operations performed	152,371
Number of postoperative emboli found at autopsy	43
Estimated total number of postoperative fatal emboli	77
Incidence of fatal emboli following operation	0.0005 or 1 in 2,000

cal diseases. In the intermediate group medical conditions still exceeded surgical ones, but the disproportion was somewhat less marked. In the group of fatal emboli the relationships were reversed, and surgical conditions exceeded medical by a ratio of 3 to 1.

In order to assay the actual hazard of pulmonary embolism in patients undergoing major surgical operations the number of fatal emboli found at autopsy in patients who had undergone surgery was compared with the total number of operations done during the time covered by this investigation. The records show that a total of 152,371 major operations were performed during these years. In the same period 43 fatal emboli were found at autopsy in patients who had undergone major surgical operations. It will be remembered that autopsy was done in 56 per cent of all the fatalities from all causes. Computed on this basis, it may be estimated that massive embolism was the primary cause of death in 0.05 per cent of patients undergoing major surgery—an incidence of 1 in 2,000 surgical operations (Table III).

Whether the fundamental illness which necessitates hospitalization is medical or surgical, it is usually recognized that old age, debility, and cardiac impairment are significant contributory factors in the etiology of pulmonary embolism. The age incidence in all emboli in this series irrespective of size or significance is recorded in Table IV. The infrequency of embolic accident in the first decades of life and the increasing incidence with advancing age, is borne out in our series. It will be noted that of the 313 cases in which the age of the patient

TABLE IV.—AGE INCIDENCE OF ALL PULMONARY EMBOLI

Years	Cases	Years	Cases
0 to 10	4	50 to 60	82
10 to 20	7	60 to 70	89
20 to 30	12	70 to 80	40
30 to 40	34	80 to 90	7
40 to 50	36	90 to 100	2

is stated, 171 (55 per cent) occurred during the two decades between 50 and 70 years of age.

The role of heart disease as a predisposing factor is stressed in most reported series of pulmonary emboli. In our study, cardiac disease, as the primary underlying disease, was recorded as follows. In the group of incidental emboli heart disease was present in 78 of 166 cases (48 per cent) in the contributory group it was found in 45 of 123 cases (37 per cent) while in the fatal emboli it was noted in only 2 of the 56 deaths (3.5 per cent). Thus it would seem that cardiac disease is an important predisposing factor in the less severe forms of pulmonary embolism but is of relatively minor significance in the etiology of major or fatal embolisms. However, it must be mentioned that myocardial impairment was listed as an associated anatomical finding in an additional 14 of the fatal cases. A very much closer relationship was noted in our series between fatal pulmonary embolism and malignant neoplastic disease. Of the 56 patients who died of pulmonary embolism not less than 20 were suffering from some form of malignant tumor. This confirms the role of debility and unpaired general health in the predisposition to pulmonary embolism.

Seasonal and climatic variations are often listed as important predisposing factors in the etiology of pulmonary embolism. We were unable to find convincing confirmation of this impression. A breakdown of all embolic cases according to the months of the year is seen in Table V. No consistent pattern is seen.

TABLE V.—SEASONAL VARIATION OF ALL PULMONARY EMBOLISM

January	28	July	26
February	30	August	18
March	30	September	28
April	28	October	28
May	39	November	10
June	15	December	27

TABLE VI.—SUMMARY OF 56 CASES

Surgical Case No. & P. Martin No.	Age Sex Date	Official diagnosis	Treatment	Preoperative symptoms	Pathology at autopsy
(1) 35 M A 7 B 3893	45 F March	Ovarian cyst	Oophorectomy	5th day after operation suddenly became unconscious and died 1 hour later	Thrombosis of right common iliac vein. Pulmonary embolism. Fatty infiltration of myocardium. At autopsy swelling of right leg was noted
(2) 35 A 733 B 6697	70 M Nov	Hypertrophied prostate	Prostatectomy	2nd day after operation sudden onset of difficulty in breathing, precordial distress and anxiety and cyanosis. Pain irregular and rapid and feeble—extreme. Died 5 hours after onset	Thrombophlebitis of left common iliac vein. Embolus in intrapulmonary branches of pulmonary artery which partially obliterated artery. Thrombus in left cardiac appendage. Early bronchopneumonia. Early pulmonary infarct. Arteriosclerosis
(3) 41 A 5 B 45 30	48 F Dec.	Uterine fibroids	Hysterectomy Bilateral oophorectomy and subperitoneal developed pneumothorax postoperatively	5th day after operation, sudden attack of acute collapse, cold perspiration and grunting for breath. Fussy cough, cyanotic but improved later. 16th day after operation developed another attack as above; however, this time she died	Thrombosis left internal podal vein. Multiple large emboli right auricle, Other and recent riding emboli of pulmonary artery. Pulmonary infarction. Acute myocarditis with fatty infiltration. Chronic passive hyperemia. No peritonitis, exudates noted or serosal walls
(4) 37 A 234 B 6643	44 F Nov	Fibrosis of sternum	Hysterectomy	7th day after operation, unsuccessful resuscitation and allowed to walk 8th day after operation, patient walked to bathroom then returned and while at stool suddenly collapsed. Became cyanotic, grunted for breath and died in 5 minutes	Thrombosis of left posterior (renal) vein. Massive riding pulmonary embolus. Recent infarct, left lower lobe. Embolus in right auricle. Left leg is larger than right.
(5) 38 A 90 B 660	40 M May	Esprit cordis—between and stitches of left ankle	Red root	Pain right chest 3 days. 5th hospital day sudden onset of dyspnea, cyanosis, cold pulse fall in blood pressure, struggled violently for breath, and died one hour later	Old hypertrophy of left lower leg. Thrombosis of left femoral vein. Riding embolus in right ventricle extending into pulmonary artery. Multiple emboli in smaller branches of pulmonary artery. Infarctions of lung
(6) 33 A 99 B 6187	40 M Mar.	Carcinoma of stomach	Gastrectomy	1st day after operation, pain on breathing left lower chest. 5th day after operation cyanosis, poor pulse. Sudden onset of restlessness, grunting for breath, clutching at chest, marked cyanosis, cold, clammy and patient died in 15 minutes.	Carcinoma of stomach with perforation. Pneumonia. Thrombosis right femoral vein. Pulmonary embolism. Both legs edematous, especially the right
(7) 33 A 103 B 6696	40 F Nov	Carcinoma of the ovary	Right oophorectomy Good postoperative course	5th day after operation sat up in chair. Patient had sudden attack of air hunger, pulse became poor and feeble, cold sweat, nausea, loss, cyanosis, coma. Died 43 minutes after onset of attack	Thrombosis of left femoral artery. Riding embolus both branches of pulmonary artery. Eight pitting edema of legs
(8) 35 M A 13 B 667	41 M	Disarticulated right femoral hernia	Operated upon and reduced	5th day after operation complained of burning and died in 7 minutes while on bed pan	Recent surgical lesions. Variation of superficial veins of lower extremities. Thrombosis of left femoral vein. Pulmonary embolism—massive chronic passive hyperemia of lungs. Acute pyelitis. Early hemorrhagic infarction of brain. Fatty myocardium
(9) 35 M A	60 F Jan	Marked obesity Ovarian cyst	Removal of ovarian cyst Good recovery	5th day after operation complained of severe pain over left lower lung area and marked breathlessness were heard satisfactorily. 16th day after operation labored, painful breathing, face cyanotic. 5th day after operation sudden attack of cyanosis, air hunger, inspiratory pain, and died in 5 minutes.	Recent surgical lesions. Bilateral pulmonary emboli. Multiple infarcts of left lower lung. Emphysema. Fatty infiltration of right ventricle. Passive congestion. No source of emboli could be found even though thorough search was carried out

TABLE VI.—SUMMARY OF 56 CASES—Continued

Surgical Hosp. No. & P. Mortem No.	Age Sex Date	Clinical diagnoses	Treatment	Premonitory symptoms	Pathology & autopsy
(c) 10 A 110 C 7064	33 F Dec.	Fibroids of uterus	Hysterectomy	Uneventful postoperative course until 10th day after operation sudden onset of patient becoming cold and clammy pulseless no blood pressure. Heart tones poor and irregular. Died 1 hour 8 minutes after onset.	Thrombosis of iliac vein Massive embolus of main pulmonary artery
( ) 36 A 163 C 7133	45 F May	Cholelithiasis	Cholecystectomy	7th day after operation out of bed, 8th day after operation out of bed, suddenly felt faint, pulseless, cyanotic, cold and clammy. Died 19 hours later.	Massive pulmonary emboli No edema of legs. Varicose vein and ulcers
( ) 37 A 64 C 9057	65 M Feb.	Mesenteric thrombosis	Bowel resection. 10th day after operation patient had secondary clonus. Also developed wound infection and pneumonia during postoperative course.	Left leg noted to be swollen on 10th day after operation. Also on 10th day after operation patient suddenly became cyanotic and gasped for breath, and became cyanotic and died in 5 minutes.	Generalized arteriosclerosis. Thrombosis superior mesenteric artery. Thrombosis left femoral vein. Massive pulmonary embolus. Marked coronary atherosclerosis. Healed infarct. Recent and organizing bronchopneumonia.
( ) 37 A 86 C 85	30 M Mar.	Fracture left femur	Closed reduction and immobilization in cast	On 10th day after operation patient was found dead. Had been talking to other patients 15 minutes earlier.	Fracture left femur. Thrombosis femoral vein. Massive pulmonary embolus. No edema of legs.
( ) 37 A 64 C 85	4 F Oct.	Acute cholecystitis	Cholecystectomy	10th day after operation while on bed pan expelling worms, patient suddenly became dyspneic, broke out in cold sweat, became cyanotic and died.	Recent embolus, pulmonary artery with complete occlusion of right and left pulmonary arteries. Multiple small pulmonary emboli in left upper lobe. Recent infarct in base left lower lobe. Recent thrombosis left femoral vein and right internal iliac vein.
( ) 37 A 78 C 90764	35 M Mar.	Incarcerated direct left inguinal hernia	Herniorrhaphy	8th day after operation helped into wheel chair; complained of dizziness, pulse became weak and patient became cyanotic. Died 4 hours later.	Massive pulmonary embolus. No edema of legs noted.
(16) 37 A 70 C 37738	61 F Oct.	Carcinoma of the ovary	Exploratory laparotomy	7th day after operation patient had sudden attack of dyspnea, became cold, pulseless and cyanotic, and died 5 minutes later.	Thrombosis of deep veins of left lower leg. Massive pulmonary embolus. Edema of both legs.
(17) 383 0 C 4900	35 F Oct.	Fibroids of uterus	Hysterectomy	10th day after operation while walking became weak and dizzy pulseless, dyspneic and died 14 hours after onset.	Thrombosis right femoral vein. Embolus in main branch of right pulmonary artery. Embolus in left pulmonary artery right thigh larger than left.
( ) 38 A 77 C 47160	51 M Sept.	Diabetic gangrene and cellulitis	Left thigh amputation	10th day after operation sudden onset of cyanosis and dyspnea while talking to wife and 1 1/2 hours later died.	Secondary suppurative of wound of left thigh. Thrombosis right posterior tibial vein. Massive pulmonary embolus. Generalized arteriosclerosis.
( ) 38 A 34 C 45904	6 F Sept.	Carcinoma of duodenum	Gastroenterostomy Diffuse peritonitis upper abdomen. Stomach postoperative course.	15th day after operation up in chair and then returning to bed suddenly seized with severe pain, nausea and dyspnea. Died in 5 minutes.	Adenoma of duodenum. Peritonitis. Thrombosis left renal vein. Pulmonary embolus. Pulmonary infarct.
(10) 38 A 33 C 5	47 F Nov.	Pregnancy	Cesarean section. 8th day postoperative wound disrupted and was resutured.	10th day after operation patient apprehensive. 11th day after operation slight cyanosis, tachycardia, dyspnea. 12th day after operation while on bed pan, patient suddenly went into shock. Blood pressure dropped to 80/50. Pulse weak and irregular and while being prepared for exploratory she died. Attack lasted 1 hour.	Recent well healed incision. Edema of right lower extremity. Pulmonary embolus—main branch of pulmonary artery. Spleenic hyperplasia.
( ) 38 A 98 C 40720	60 M Apr.	Carcinoma of sigmoid with perforation	Crotonotomy and drainage	8th day after operation pulse in left lower chest. 10th day after operation friction rub—infarct? Pulse suddenly became imperceptible and patient died.	Massive pulmonary embolus. Thrombosis deep vein right leg. Bronchopneumonia.



TABLE VI.—SUMMARY OF 56 CASES—Continued

Surgical Hosp. No. & P. Mortem No.	Age Sex Date	Clinical diagnoses	Treatment	Premortuary symptoms	Pathology at autopsy
(30) 40 A 44 C 7357	50 F Nov	Acute cholecystitis	Cholecystectomy and appendectomy	Patient ran typical course with weak pulse, temperature of 101° to 102° and 0.6° dyspnea, and no cyanosis. 14th day after operation patient was improved. 16th day after operation patient suddenly became cyanotic and dyspneic, pulse became rapid and weak and patient died within a few minutes.	Localized peritonitis at hilus and organized peritonitis in fossa of gall bladder Hemorrhage over anterior surface of liver over posterior and lateral surface of colon. Phlebotrombosis left posterior tibial vein. Large embolus left pulmonary artery
(31) 40 A 15 C 66014	7 F Apr	Diabetes Cellulitis right leg	Symptomatic treatment	While in hospital had a "stitching" pain across the lower chest and could not breathe. 7 days later patient was discharged from the hospital, and while on the way home in the taxi, patient suddenly became short of breath, cold, cyanotic and died in 40 minutes. At autopsy left calf found to be larger than right leg.	Phlebotrombosis of left posterior tibial veins. Multiple pulmonary emboli, old and recent. Pulmonary hemorrhage right lower lobe. Generalized arteriosclerosis. Minute foci of bronchopneumonia
(32) 41 A 14 C 69438	4 M Mar	Hernia	Hernia repair	Patient had bilateral hernia repair. Developed sharp pains in chest; pulse weak by counting. Also had elevated pulse. During following weeks patient had episode of chest pains, fever, blood-tinged sputum, pleural friction rub, dyspnea and tachypnea. 10th day after operation swelling of entire left leg noted and saphenous vein was palpated and red streak was present in left thigh. 16th day after operation patient suddenly died with attack of dyspnea, tachypnea, cyanosis, shock and weak irregular pulse.	Recent organizing and organized thrombi in left common iliac, external iliac femoral and saphenous veins and deep venae cavae. Multiple bilateral recent and or ganized pulmonary emboli. Recent and organized pulmonary infarcts of lower lobes. Organizing pleuritis lower left lobe. Swelling of entire left leg
(33) 4 A 73 C 950	45 F Mar	Intestinal obstruction	Exploratory laparotomy and at surgery large ovarian cyst was found attached to the descending colon which could not be removed. Patient went into shock after surgery and developed peritonitis. Became distended and a cystectomy was done.	5 days after cystectomy suddenly became dyspneic and cyanotic and died in a few minutes.	Propagating embolus of main pulmonary artery. Swelling of both legs. Veins of pelvis thrombosed. Adenocarcinoma of descending colon with marked narrowing of lumen. Acute fibrinopurulent peritonitis. Pyelonephritic and arteriosclerotic scars of kidneys
(34) 41 A 9 C 69433	64 M Feb.	Cataract of left eye	Surgery for cataract of left eye	Postoperative course uneventful until 4th day. Temperature went to 101°. 6th day after operation patient felt dizzy and became cold, clammy, pupils profusely. Pulse became rapid, weak and blood pressure fell. 7th day after operation another attack occurred with slight cyanosis. 8th day after operation temperature rose, and from then on started down. 10th day after operation patient became cyanotic, cold, clammy, rapid pulse and weak and died shortly thereafter. Patient also coughed up blood-tinged mucus prior to death. At autopsy left leg found to be larger than right leg.	Phlebotrombosis of left hypogastric vein. Multiple massive pulmonary emboli. Pulmonary infarction right lower lobe. Acute fibrinous pleuritis. Atherosclerosis of left lower lobe. Arteriosclerosis
(35) 4 A 43 C 159	67 F Apr	Carcinoma at junction of descending and sigmoid colon	Transverse colectomy	4th day after operation sudden onset of tachycardia to 140, tachypnea to 36. Præcordial pain, dyspnea, cyanosis, slight cough and apprehension. 7 days later patient had sudden attack of dyspnea, shallow respiration, cold clammy skin and death in an hour.	Phlebotrombosis of left popliteal vein. Multiple pulmonary emboli. Primary adenocarcinoma of tumor. Hemorrhages with early infarcts of both lower lobes of lungs. Focal fatty degeneration of myocardium and myocardial fibrosis



TABLE VI.—SUMMARY OF 56 CASES—Continued

Surgical Hosp. No. & P. Mortum No.	Age Sex Date	Clinical diagnoses	Treatment	Premonitory symptoms	Pathology at autopsy
(41) 45 A 43 D 50946	51 F Feb.	Carcinoma of caecum	Resection of carcinoma and primary anastomosis	Patient went into shock following surgery and day after operation sutures were removed and patient developed a coughing spell and wound disrupted and had to be closed. 6th day after operation patient suddenly became cold and clammy with rapid respirations and died shortly thereafter	Phlebotrombosis of right common iliac vein. Papilliferous adenocarcinoma of the caecum. Large pulmonary embolus lodged in trunk of pulmonary artery. Multiple small emboli of lungs. Marked passive hyperemia of abdominal viscera. Thrombosis of branch of portal vein. Multiple myxoidomas of uterus. Metastatic nodules in the liver.
Medical Hosp. No. & P. Mortum No.	Age Sex Date	Clinical Diagnoses	Treatment	Premonitory Symptoms	Pathology at Autopsy
(42) 31 A 188	67 M. Sept.	Prostatic hypertrophy	Medical	After admission, had what appeared to be a typical attack of coronary occlusion. 4th day after admission, set on commode to pass urine, no success, and returned to bed, was sitting up, suddenly head fell forward, became weak, cold clammy sweat, pulseless and died	Early organizing thrombus of right femoral and iliac veins. Massive filling embolus of both pulmonary arteries. Hypertrophy and dilation of heart. No external evidence of edema of legs seen
(43) 1 A 16 B 50964	64 M. June	Carcinoma of pancreas; diagnosed at exploration 4 months previous	Medical	16 days after admission, patient was found dead while sitting on toilet	Thrombosis of common iliac veins. Massive pulmonary embolus. Edema of both lower legs
(45) 35 A 8 B 86061	47 M. Feb.	Partial bowel obstruction	Medical	Found on floor of bathroom by nurse, semiconscious, rapid shallow respiration, pallor, pulse of 20, no blood pressure, and died one hour later	Lymphosarcoma of stomach. Thrombosis left femoral vein. Bilateral pulmonary embolus. The left thigh is slightly larger in circumference than the right
(47) 48 A 35 C 50	77 F. Feb.	Arteriosclerosis	Medical	26th day patient went to washroom and on returning complained of epigastric pain, developed tachycardia, became cyanotic and died in 40 minutes	Thrombosis right posterior tibial vein. Multiple pulmonary emboli. Right leg slightly larger than left
(48) 28 A 21	38 M. May	Tuberculous arthropathy Cord bladder	Medical	While receiving enema became cyanotic, breathing labored, pulse imperceptible died in 1 hour	Tuberculous. Acute suppurative arthritis left knee. Thrombosis of veins of calf of left leg. Massive pulmonary embolus.
(49) 30 A 06 C 64797	63 Sept.	Hypertension and precordial distress	Bed rest at home 5 weeks prior to entry into hosp.	Had pains in left leg. Also had vertigo and surrounding redness of left leg and induration of heart	Old and recent thrombosis of superficial veins of left lower leg. Massive pulmonary embolus (left and right subdivisions of the pulmonary artery) and multiple emboli to radicles of both divisions of pulmonary artery. Multiple pulmonary infarcts. Mural thrombus right ventricle. Myocardial fibrosis
(50) 41 A 41 C 90910	67 F. May	Carcinoma of uterus	In hospital for observation. Had 2-3 year history of vaginal bleeding. Dyspnea, orthopnea, cough, ankle edema, hemoptysis	While attempting portable x-ray of abdomen, patient screamed, gasped, and died suddenly	Primary polymorphous sarcoma of uterus. Phlebotrombosis of right iliac vein. Recent and old embolism to both pulmonary arteries. Hypertrophy and dilatation of heart
(51) 41 A 38 D 35	43 M. Oct.	Carcinomatosis	Symptomatic	Pains right lateral thigh 3 weeks. Severe epigastric pains. Blood pressure fell. Pulse rate increased and patient became cyanotic, cold and died suddenly	Phlebotrombosis of popliteal and calf veins right leg. Massive pulmonary embolus. Lymphosarcoma involving retroperitoneal, mediastinal, peritoneal and intracavitary nodes with extension to pancreas, gastroduodenal tract, esophagus and pericostae.





We were greatly concerned with the source of the embolism the type of vein disease which produced the embolus and the clinical signs of danger from impending embolic accident. The source of the embolus was not found in 7 cases and there were 3 additional cases in which the source was not found, but the leg veins had not been examined. The deep veins of the lower extremities gave rise to the embolus in 43 of the remaining cases and the prostatic, pudendal, and left renal vein each contributed one fatal embolus. There were no fatal emboli from thrombi or phlebitides in the superficial veins of the lower extremities.

As already stated 53 of the 56 fatal emboli arose from bland thrombi and in only 3 cases in this series was the diagnosis of thrombophlebitis made. In these 3 cases there was sufficient clinical evidence to support a diagnosis of deep vein thrombophlebitis of the lower extremities. In all of these however, the embolus was apparently a portion of non infected clot. It is entirely probable that in all 3 of these instances, a bland thrombus developed as a 'tail-part' to a thrombophlebitic process, and that it was this noninflamed non adherent portion which broke loose to constitute the embolus. These 3 cases are abstracted below.

CASE 29 No. 39 A 258—C 66766 White male aged 69 years entered the hospital because of prostatic hypertrophy. A suprapubic cystotomy was done on October 9, 1939. On October 13 while sitting up in chair patient had severe abdominal and back pain. On October 19 he complained of severe left chest pain while lying in bed. Also he had a rapid pulse at the same time. No swelling of legs was noted at this time. On November 5, 1939, the left leg became warm painful and edematous the left thigh measured 3 centimeters greater in circumference than the right thigh. He was treated with rest elevation and heat. The electrocardiogram reading was compatible with that for pulmonary infarct. On November 10 he suddenly gasped for breath and died.

Pathological diagnosis thrombophlebitis of left femoral vein multiple large riding emboli of pulmonary arteries old thrombi in smaller pulmonary arteries myocardial fibrosis benign prostatic hypertrophy suprapubic cystotomy.

CASE 32 No. 41 M A 14—C 69428 White male, aged 41 years, entered the hospital for a bilateral herniorrhaphy. He developed a sore throat after operation. Twelve days postoperative the patient developed sharp pains first in the right chest and later in the left chest which were made worse by

TABLE VII.—OPERATIONS IN WHICH DEATH WAS DUE TO PULMONARY EMBOLISM

Pelvic laparotomy	10
Cecostomy (peritonitis)	5
Prostatectomy	4
Cholecystectomy	3
Herniorrhaphy	3
Bowel resection	2
Thigh amputation	1
Gastroenterostomy	1
Adrenalectomy	1
Urethral transplantation	1
Thoracoplasty	1
Mastectomy	1
Cesarean section	1
Cystostomy	1
Colostomy	1
Cataract operation	1
Drainage of abscess	1
Bloody of cervix	1
Radium insertion	1
No operations	4
Immobilization of fractured femur	2
Cellulitis of leg (diabetes)	1
Bed rest for multiple contusion	1

deep breathing or coughing. During the following weeks he had episodes of chest pain fever blood tinged sputum pleural friction rub dyspnea tachypnea and cyanosis at times. On the 19th postoperative day swelling of the entire left leg was noted the saphenous vein was palpable and tender and a red streak was present in the left thigh. About the 60th postoperative day the patient suddenly died with an attack of dyspnea, tachypnea, cyanosis and shock.

Pathological diagnosis. Healed surgical incisions (2) for bilateral inguinal hernia recent organizing and canalized thrombi in left common iliac, femoral saphenous veins and deep vena cavae of left leg with phlebosclerosis multiple bilateral recent and organized pulmonary emboli recent and organized pulmonary infarcts of lower lobes organizing pleuritis left lower lobe dilatation right ventricle edema left lower leg.

CASE 38 No. 42 A 271—D 19473 White male aged 58 years entered the hospital for the surgical removal of a right adrenal cyst. Ten days after operation the patient developed pains in the right calf with an elevation of temperature. The right leg was found to be swollen and tender. Thrombophlebitis was diagnosed and x ray treatments and immobilization were prescribed. Fever and swelling of the leg persisted and at times patient had chills. On the 20th postoperative day the patient had sudden, severe dyspnea with immediate pallor. He was given intravenous papaverine atropine intracardiac adrenaline coramine oxygen and artificial respiration, but the patient stopped breathing in 5 minutes and the heart stopped beating several minutes later.

Pathological diagnosis absence of right suprarenal gland thrombosis of right iliac and femoral veins massive pulmonary embolus acute and chronic passive hyperemia of lungs myocardial fibrosis arteriosclerosis, multiple polyps of the rectum.



In a comparable group of 458 patients undergoing the same types of operation, 55 cases of thromboembolic syndrome were noted, with 26 instances of fatal pulmonary embolism. There was one embolic death in the ligated series. Allen therefore estimates that 25 lives were saved by the ligations in this small series of patients. Admitting that Allen's series constitute a selected group of patients from the standpoint of age, it is nevertheless striking that in our surgical material 52,000 consecutive major operations would be required to furnish the number of embolic deaths which he encountered in 458 cases! Similarly, Thebault and Ward recommend ligation of the inferior vena cava as the procedure of choice in thromboembolic disease. In their series of 36 cases there were 4 deaths and 2 additional deaths followed bilateral femoral vein ligations. The mortality and morbidity under this regimen should be weighed against the dangers of the disease without operation as revealed in our material.

The embolic cases in our series have been broken down according to whether the underlying illness was medical or surgical. It was found that in the less significant types of embolism medical conditions outnumbered surgical almost two to one. In the fatal emboli however there were almost three times as many surgical cases as medical. It has been pointed out that the incidence of death from massive pulmonary embolism following operation is far lower than we have been led to believe. Of the 152,371 major surgical operations performed during the period of this study, there was an estimated total of 77 deaths from pulmonary embolism. This gives an incidence of 1 in 2,000 operations and serves to indicate the actual postoperative risk from this complication. Whatever prophylactic and therapeutic measures are contemplated should be weighed in terms of the actual hazard which prevails. The relation of fatal embolus to antecedent vein disease aids in establishing the indications for the various therapeutic measures which have been advocated in thromboembolic disease. Inasmuch as almost all of the fatal emboli arose from bland thromboses our data confirm the long held belief that thrombophlebitic vessels carry

very little hazard of pulmonary embolism. On the other hand, the noninflamed, relatively asymptomatic bland thrombi constitute the source of real danger of embolic death.

The therapeutic implications from these facts seem clear. Phlebothrombosis is recognized as a serious threat of death from pulmonary embolism. Once formed further propagation of the thrombus can be prevented by the use of anticoagulants. This does not however, reduce the danger of embolism from the thrombus which is already present. The only safeguard against embolic death which we can offer in the presence of phlebothrombosis is the interruption of the venous trunk above the site of thrombosis.

Thrombophlebitis on the other hand carries with it very little risk of massive embolism other than that inherent in the possible bland thrombus which may extend by propagation from the phlebitic vein segment. Ligation therefore would not seem to be indicated. However, the use of anticoagulants to prevent the formation of a bland thrombus should serve to eliminate what little hazard exists in this condition. In view of the usual sudden onset of thrombophlebitis, its presence is announced by pain, fever, swelling and tenderness in sufficient time to permit the administration of anticoagulants for the prevention of phlebothrombotic extension.

On the basis of these general rules we have adopted the following regimen in the management of these vein complications. If a diagnosis of phlebothrombosis is made on the presence of local findings in the lower extremities, namely pain and soreness in the leg or foot, tenderness to pressure in the calf, pain on dorsiflexion of the foot (Homans sign) or edema, ligation is done at the level of the superficial femoral vein on the side presenting the findings. If there are no evidences of phlebothrombosis on the opposite side only a unilateral ligation is done. If present on both sides bilateral ligation is obviously indicated. Should the indications for ligation be a premonitory pulmonary infarction and should there be no local signs to indicate from which leg the embolus originated, one is compelled to do a bilateral ligation. As to the site for ligation as stated we consider the superficial



# HEMOLYSIS DURING TRANSURETHRAL PROSTATIC RESECTION

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THE presence of excess amounts of free hemoglobin in the blood plasma of many patients immediately after transurethral prostatic resection has been recognized since Creevy and Wehh reported its presence in a case in which oliguria and uremia developed after transurethral resection. They credited Emmett and McLaughlin with suggesting the possibility that sterile water used as an irrigating fluid during transurethral resection enters the circulation via prostatic veins and hemolyzes erythrocytes to an extent sufficient to damage the kidneys exactly as does a transfusion with incompatible blood. Subsequently McLaughlin and his co-workers reported 3 cases in which oliguria developed after transurethral resection. They found that the pathologic lesion in the kidneys in 1 of these cases was similar to the lesions observed in cases in which hemoglobinemia developed after transfusion with incompatible blood. Later Landsteiner and Finch reported significant post-operative hemolysis in 10 of 15 patients who underwent transurethral resection.

The purpose of this paper is threefold. First we intend to review the fundamental research and knowledge on which the present concept of hemoglobinemia and hemoglobinuria is based. Second we wish to report the results obtained from our study of 100 patients on whom determinations of plasma hemoglobin were done immediately after transurethral resection. Last we will interpret the results of our study on the basis of concepts of hemoglobinemia previously reviewed.

## **PATHOLOGIC PHYSIOLOGY OF HEMOGLOBINEMIA AND HEMOGLOBINURIA**

*Normal disposition of hemoglobin.* Normally in the adult human being approximately 1.9 per cent of the circulating erythrocytes are destroyed each 24 hours, this destruction re-

sults in the liberation of between 7 and 8 grams of hemoglobin each day. Destruction of these erythrocytes with release of hemoglobin takes place within the cells of the reticulo-endothelial system. From this released hemoglobin the reticulo-endothelial cells metabolize bilirubin which is subsequently excreted by the liver. Theoretically, this process is an intracellular one and the hemoglobin does not escape into the circulating blood plasma. Actually however, 100 cubic centimeters of normal human plasma contains 2 to 5 milligrams of free hemoglobin that is pigment derived perhaps from actual intravascular destruction of erythrocytes (44).

*Disposition of free hemoglobin in the plasma.* When an abnormal quantity of free hemoglobin is present in the plasma the reticulo-endothelial cells continue to convert this pigment to bilirubin (44). However, if the hemoglobin is liberated faster than its conversion to bilirubin then hemoglobinuria may occur. Similarly, if the amount of heme pigment formed is greater than can be excreted by the liver, retention of this product in the plasma results in hemolytic jaundice (5).

After intravenous injection of hemoglobin into dogs, Gilligan and associates found that less than 15 per cent of the total was excreted in the urine. Flunk found when he injected larger quantities of hemoglobin intravenously that 25 to 40 per cent of the total hemoglobin in the plasma was so excreted. In one of their patients O'Shaughnessy and his associates reported that 20 per cent of the total amount of circulating hemoglobin in the plasma was excreted in the urine. Supposedly the remaining 60 to 85 per cent of hemoglobin in the circulating plasma is metabolized by the reticulo-endothelial cells into bilirubin excreted later by the liver or retained in the plasma.

Hemoglobin is removed from blood plasma fairly rapidly. Gilligan and his co-workers injected hemoglobin into human beings and determined the length of time required to clear

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the plasma of hemoglobin. They found that if the concentration of hemoglobin was 40 to 60 milligrams per 100 cubic centimeters of plasma, 5 hours were required for its value to return to normal when the concentration was 130 to 225 milligrams per 100 cubic centimeters, 8 hours, and when it was 280 to 380 milligrams, 12 hours. In other words, the higher the concentration of hemoglobin in the plasma the longer the clearance time.

When hemolysis is extensive the concentration of hemoglobin in the plasma rises until hemoglobin appears in the urine. A definite renal threshold for the excretion of hemoglobin has been determined for both man and dog. Monke and Yule could not detect any hemoglobin in the urine of dogs as long as the level of plasma hemoglobin remained less than 80 to 100 milligrams per 100 cubic centimeters when the concentration was higher however hemoglobin appeared in the urine. In man Ottenberg and Fox found the renal threshold for the excretion of hemoglobin to be variable. In some persons hemoglobinuria developed when the level of hemoglobin was 110 milligrams per 100 cubic centimeters of plasma in other persons even though the plasma hemoglobin attained levels of 200 to 288 milligrams per 100 cubic centimeters, no hemoglobin appeared in the urine. Similarly Gilligan and his associates observed hemoglobin in the urine of those human beings who had concentrations of plasma hemoglobin of more than 135 milligrams per 100 cubic centimeters.

#### PATHOLOGIC RESULTS OF HEMOGLOBINEMIA AND HEMOGLOBINURIA

Our main interest in hemoglobinemia and hemoglobinuria is to determine whether the presence of free hemoglobin in plasma is harmful to patients undergoing transurethral resection. Some evidence concerning such a possibility may be gathered by reviewing the experiences of others who have injected hemoglobin into animals and man.

*Results from injection of hemoglobin in man.*—Allards and Minot and Ottenberg and Fox injected hemoglobin intravenously into human beings and noted either a mild reaction characterized by a chill with subsequent hot and cold flushes or no reaction at all.

O'Shaughnessy and associates, Fairley and Gilligan and co-workers observed untoward reactions characterized by chills, fever, nausea, abdominal cramps, pain in the back and loins and sensations of constriction in the chest following the intravenous injection of a solution containing hemoglobin. These symptoms parallel those noted in clinical hemolytic syndromes. However no one has reported injecting sufficient hemoglobin into human beings to cause renal damage with oliguria similar to that in clinical hemolytic states. Amounts of hemoglobin sufficient to produce renal damage have been injected into animals.

*Experimental production of renal damage by injection into animals of solutions containing hemoglobin.*—Ponfick produced hemoglobinuria by injecting heterologous blood into animals. He found pigmented casts deposited in the renal tubules of these animals.

Levy and Yorke and Nauss succeeded in reproducing renal damage similar to that observed in blackwater fever by injecting solutions of pure hemoglobin and homologous and heterologous laked blood into rabbits.

Baker and Dodds produced a marked rise in the values for nonprotein nitrogen in the blood of rabbits with acid urine by the intravenous injection of hemoglobin but noted no such phenomenon when the urine was alkaline. They concluded that precipitation of hemoglobin pigment in acid urine caused mechanical obstruction of renal tubules and resulted in suppression of urinary excretion.

DeGowin and co-workers (14, 15) showed that a high percentage of dogs with strongly acid urine succumbed to transfusions of large amounts of laked red blood cells while death did not follow similar injections if the urine of the animal was alkaline. The cause of death was uremia and pathologic examination of the kidneys disclosed changes similar to those found in other types of oliguria.

Most recently Flink injected high dosages of hemoglobin intravenously into dogs that had either acid or alkaline urine and produced renal insufficiency in both. He found that the development of renal insufficiency in these dogs depended on the concentration of hemoglobin in the plasma immediately after the injection of the hemoglobin. An initial con-

centration of 3,700 milligrams of hemoglobin per 100 cubic centimeters of plasma or more was noted in all of the dogs in which renal insufficiency developed

#### THE OLIGURIA SYNDROME

We will consider the oliguria syndrome, that is, primary oliguria and its associated symptoms in some detail because the coincidental occurrence of hemoglobinemia and oliguria in patients who have undergone transurethral resection has stimulated the belief that hemoglobinemia may be an important factor in causing the oliguria.

Oliguria following transurethral resection usually develops in cases in which the surgeon has encountered some difficulty such as rupture of the prostatic capsule excessive hemorrhage or opening of periprostatic venous sinuses. In such cases, typical oliguria or anuria may develop. A progressive rise in the concentration of nitrogenous waste products in the blood occurs. Early the patient may suffer from anorexia, nausea and vomiting but as the syndrome progresses these symptoms usually disappear and the patient feels relatively well. Many of these patients die of renal insufficiency but some ultimately excrete urine and recover spontaneously.

The oliguria syndrome following transurethral resection is not different in any respect from the oliguria syndrome known to occur in a wide variety of acute illnesses. Oliguria is associated with pigment in the patients' blood and urine in blackwater fever (4, 24, 50), hemolytic transfusion reactions (2, 15, 16, 24), severe burns (46), obstetrical mishaps (39, 52), acute hemolytic anemia secondary to sulfonamide therapy (23) and the crush syndrome (8-10, 18). Macgrath, Havard and Parsons have examined the literature however and found that the syndrome develops in many conditions in which abnormal pigment may be absent from the urine. These may include the alkalosis of gastric tetany, septic abortion, cholera, yellow fever, diabetes, the hepatorenal syndrome, traumatic uremia, carbon monoxide poisoning, and pernicious anemia. Creevy also has pointed out that postoperative uremia may be due to acute pyelonephritis prolonged severe hypotension, caused by

hemorrhage, anesthesia or surgical shock, or to trauma to the ureteral orifices with resultant hydronephrosis.

Pathologic changes found in the kidney at necropsy in those cases in which patients died from this syndrome are strikingly similar no matter what the initial illness was (2, 7, 15, 26, 32). Characteristically, the glomeruli appear almost normal, some edema and cellular infiltration of the interstitial tissue may be present, but the outstanding changes are in the renal tubules. Degenerative changes occur especially in the loops of Henle and the distal convoluted tubules, and these may vary from mild vacuolization to necrosis and desquamation of cells. Granules of varying size may be noted in the epithelial cells of the convoluted tubules. Deposits of calcium in the degenerated tubules and signs of regeneration of epithelial cells have been found. At times a variable number of deeply pigmented casts appear in lumina of loops of Henle, distal convoluted tubules and the collecting tubules.

The mechanism of the development of this syndrome is not definitely known. The four main theories are (1) mechanical blockage of renal tubules, (2) a humoral nephrotoxic substance, (3) renal anoxia and (4) renal arteriovenous shunts.

The concept of mechanical blockage by precipitation of hemoglobin pigment in the renal tubules is based on experimental work on the development of renal insufficiency after the injection of hemoglobin in animals with acid urine (3, 4). Theoretically, hemoglobin is thrown out of solution when the intratubular fluid becomes sufficiently acid and when simultaneously through absorption of water the concentration of sodium chloride is increased to about 1 per cent. These requirements are met in the lower nephron (that is the distal loop of Henle and the distal convoluted tubules) and in the collecting tubules the sites where cast formation is usually found (32).

Many investigators agree with the theory of mechanical obstruction but some believe that cast formation is secondary to the tubular epithelial degeneration and is not the cause of renal insufficiency per se (2, 16, 26). Experimentally Yuile, Gold, and Hinds showed that hemic pigment is precipitated in tubules pre-



visuously damaged by ischemia or by chemical poison. Their results indicate that precipitation of casts coincides with tubular damage. Bing has shown that renal insufficiency may develop without the precipitation of pigmented casts within the tubules. Flink produced renal insufficiency by injecting large doses of hemoglobin into dogs having either acid or alkaline urine. Clinically fatal anuria following hemolytic transfusion reaction has occurred in the human being despite alkalization of the urine and is no more common in blackwater fever in patients with acid than in those with alkaline urine (16 24 53).

The theory that some vasoconstrictive or nephrotoxic substance released into the circulation induces renal damage and insufficiency is frequently mentioned but remains nebulous. DeGowin and co-workers (15) concluded that some factor other than tubular obstruction causes renal changes in this syndrome because in most of their 9 cases of 'transfusion kidney' not enough tubules were obstructed to produce any important diminution in renal function. They postulated that a substance toxic to kidneys may be liberated by intra-vascular hemolysis.

According to the renal anoxia theory renal damage is caused by diminished supply of oxygen to the kidneys resulting from disturbance of renal blood flow which follows peripheral circulatory failure. The blood flow in the kidney can vary independently of the general circulation so that while the total volume of circulating blood may decrease in shock to approximately half of the normal value, the flow of blood through the kidney may decrease to one-tenth one-twentieth, or even less of the normal flow (30 43 49). Various investigators including Phillips and associates and Corcoran and Page (11) have observed vasoconstriction of renal blood vessels during hemorrhagic shock to the point of almost complete absence of renal circulation. Such reduction of flow not only leads to diminished filtration force within the glomerular capillaries but also to diminished peritubular circulation and reduction in essential oxygen supply with consequent tubular damage. The presence of an excess amount of hemoglobin in blood plasma also may contribute to this renal

anoxia by producing vasoconstriction since a definite shrinkage of the kidney has been detected immediately after the intravenous injection of laked red blood cells in the dog by Levy and of hemoglobin solution in the dog and frog by Mason and Mann and in the dog by Hesse and Filatov. Apparently the duration of ischemia is an important factor in determining the extent of renal injury. Van Slyke for example has shown that severe reduction of the renal blood flow during circulatory failure for a period of hours following hemorrhage is often followed by markedly impaired renal function and pathologic changes in the kidneys consisting chiefly of tubular necrosis and the presence of pigment casts in the tubules. These are changes not unlike those described in the oliguric syndrome of human beings. Supposedly oliguria develops when tubular cells are damaged to such an extent that reabsorption of glomerular filtrate becomes unselective (17 32 42). In other words, the permeability of the necrotic cells is altered so that the osmotic pressure of the blood in the peritubular capillaries is able to draw back all or practically all of the normal glomerular filtrate and a scanty volume of urine is passed.

More recently Trueta has demonstrated that in certain oliguric states the blood passes from artery to vein through arteriovenous shunts in the kidney in this manner the blood does not reach the renal cortex.

Thus, hemoglobinemia during transurethral resection may be one of several factors inducing oliguria following resection by tubular obstruction, nephrotoxic effect or vasoconstriction.

#### HEMOLYSIS DURING TRANSURETHRAL PROSTATIC RESECTION IN 100 PATIENTS

Since hemoglobinemia in patients is known to follow transurethral resection we have been investigating the incidence of hemoglobinemia, the factors which may accompany or predispose to its development, and the possible postoperative ill effects in cases in which hemoglobinemia follows transurethral resection. This report is based on a study of 100 cases in which the concentration of plasma hemoglobin was determined after transurethral prostatic resection at the Mayo Clinic.

TABLE I — VALUES OF PLASMA HEMOGLOBIN IN 100 CASES AFTER TRANSURETHRAL PROSTATIC RESECTIONS

Plasma hemoglobin, mgm. per 100 c.c.	Type of estimation		Total cases
	Quantitative	Qualitative	
50-100	6		6
30-400*	6		6
20-300	3		4
10-200	3		4
5-100	8	8	26
0-15	20	35	44

\*No values from 40-300 mgm. in our series.

TABLE II — POSTOPERATIVE VALUES OF PLASMA HEMOGLOBIN IN RELATION TO CONDITION FOR WHICH PROSTATIC RESECTION WAS PERFORMED

Condition	Plasma hemoglobin, mgm. per 100 c.c.	
	5 or less	More than 5
Benign prostatic hyperplasia	27	5
Carcinoma of prostate	5	4
Contracture of vesical neck		
Vesical neoplasm with extension to prostate		
Total cases	44	95

**Method of study** The method of study has been as follows. The concentration of hemoglobin in the plasma was determined in 100 cases taken at random from those in which transurethral resections were performed at the clinic during the months of April to July, 1947. The incidence of hemoglobinemia in this series was calculated and any factors which may possibly accompany or predispose to hemoglobinemia were studied. These factors included the weight and nature of the tissue resected, the loss of blood and the difficulty of resection reported by the surgeon. Finally the series was analyzed for such possible postoperative ill effects secondary to hemoglobinemia as fever, chill, gastrointestinal symptoms and oliguria after resection.

The technique for determining the quantity of free hemoglobin pigment in the plasma was adapted from that of Flink and Watson. This method depends on conversion of derivatives of hemoglobin pigment to pyridine ferrohemochromogen whose absorption is measured with a photoelectric colorimeter which has been calibrated previously with known quantities of hemoglobin. In order to avoid artificially induced hemolysis the blood must be collected carefully. We used a dry syringe with a close fitting 19 gauge needle and took precautions to draw the blood slowly and carefully. Collapse of the vein wall on the needle, circulation of air bubbles in the blood or too rapid withdrawal of the blood all induce artificial hemolysis. The blood was then gently emptied into a graduated centrifuge tube which contained either 0.5 cubic centimeter

of 3 per cent solution of sodium citrate or powdered heparin. The blood and anticoagulant were mixed by careful inversion and centrifuged. When heparin was used as an anticoagulant we obtained best results by dusting a small quantity on the portion of the syringe plunger which was in contact with the blood. We departed from Flink's technique in that we used a Kolmer colorimeter instead of an Evelyn and also used slightly different quantities of plasma and reagents. When larger amounts of plasma than 0.5 cubic centimeter were employed we encountered difficulty with turbidity. Consequently, 0.1 to 0.5 cubic centimeter of plasma was placed in a colorimeter tube. To this was added sufficient amount of 1 per cent solution of ammonium hydroxide to bring the volume to 4.5 cubic centimeters. The volume was then increased to 6.0 cubic centimeters by the addition of 0.5 cubic centimeter of pyridine and 1.0 cubic centimeter of a 2 per cent solution of sodium hyposulfite ( $\text{Na}_2\text{S}_2\text{O}_4$ ) freshly prepared in 1 per cent solution of ammonium hydroxide. A duplicate tube was set up in a similar manner with 0.5 cubic centimeter less of ammonium hydroxide to allow for the addition of 0.5 cubic centimeter of hydrogen peroxide and 5 minutes were allowed for decolorization. Then, after the center setting of the colorimeter was determined by use of the duplicate tube, the galvanometer reading of the unknown solution was determined. By applying this to the calibration curve the hemoglobin content of the specimen was calculated.

Actually hemolysis of any significant amount can be estimated by gross examina-

TABLE III.—POSTOPERATIVE VALUES OF PLASMA HEMOGLOBIN IN RELATION TO SURGICAL FACTORS

Plasma hemoglobin, mgm per 100 c.	Cases	Average weight of tumor, gm	Average blood lost, cc	Operative difficulties, per cent
100-1,000	6	36	365	100
300-400	6	30	165	67
100-300			497	75
100-200	14	41	294	50
10-100	16	5	245	50
0-10	44	20	55	50

tion of the patient's plasma after the blood has been centrifuged. The color of the plasma reflects the concentration of hemoglobin pigment. Thus, when expressed in approximate values, yellow plasma contains little or no hemoglobin, yellow with a slight pink tinge contains 25 to 30 milligrams, orange 30 to 65 milligrams, and pink 65 to 125 milligrams per 100 cubic centimeters. When more than 125 milligrams is present, the plasma is colored gradually deepening shades of red.

*Results of investigation.* Of the 100 patients in this series, 44 had 25 milligrams or less of hemoglobin per 100 cubic centimeters of plasma and 56 had levels above this figure (Table I). We used 25 milligrams per 100 cubic centimeters as a dividing point because gross hemolysis is first visible at this concentration and some of our determinations are based on gross observations only. (The actual upper limits of normal for plasma is 5 milligrams per 100 cubic centimeters.) The incidence of hemolysis in relation to the nature of the obstruction for which transurethral prostatic resection was performed is listed in Table II. The incidence of hemolysis was essentially the same for both benign and malignant lesions of the prostatic gland. Sterile water was used as the irrigating solution in all cases of this series. In a small group of patients not included in this study however both glycine and physiologic saline solution were used as irrigating solutions without appreciable postoperative hemolysis.

The operative factors which may accompany or predispose to hemoglobinemia are summarized in Table III. This table shows that the average weight of tissue removed in

cases in which the level of plasma hemoglobin after operation was more than 25 milligrams per 100 cubic centimeters was greater than in cases in which it was 25 milligrams or less. However the general rule that hemolysis occurs more commonly after removal of larger amounts of tissue is not invariable because in 2 cases of the series in which 9 and 7 grams of tissue were removed, the concentration of plasma hemoglobin after operation was 516 and 204 milligrams per 100 cubic centimeters respectively. On the other hand each of 4 patients in the group with little or no hemolysis had 50 grams or more of tissue removed.

In general the average volume of blood lost at operation has been found to be higher in those cases in which the level of plasma hemoglobin was more than 25 milligrams per 100 cubic centimeters than in other cases. There were exceptions to this general rule also. Three patients who lost 45, 40, and 30 cubic centimeters of blood at operation had postoperative concentrations of hemoglobin of 384, 335 and 379 milligrams per 100 cubic centimeters of plasma, respectively. Conversely 4 of those who did not have appreciable postoperative hemolysis lost more than 300 cubic centimeters of blood at operation.

The difficulty of resection and the level of postoperative hemoglobinemia appear to be definitely related. The surgeon encountered difficulty in 50 to 100 per cent of the cases in which the concentration of plasma hemoglobin after operation was more than 100 milligrams per 100 cubic centimeters. By contrast, the surgeon reported difficulty in only 20 per cent of all cases in which the postoperative level of plasma hemoglobin was less than 100 milligrams. The difficulties encountered by the surgeons in these cases are detailed in Table IV. This table shows that in all 6 cases in this series in which the postoperative concentration of plasma hemoglobin was more than 500 milligrams per 100 cubic centimeters the operations were performed with difficulty. In 4 of the 6 cases operative bleeding was controlled with difficulty in 1 case perforation of the urethra and in 1 opening of a definite venous sinus occurred. Similar difficulty was encountered during operation in 4 of the 6 cases in which the postoperative level

TABLE IV — POSTOPERATIVE VALUES OF PLASMA HEMOGLOBIN IN RELATION TO SURGICAL DIFFICULTIES

	Plasma hemoglobin, mgm. per 100 c.c.					
	50-100	101-200	201-300	301-400	401-500	501-600
Total cases	6	6	4	24	26	41
Excessive bleeding	4					
Perforation prostatic urethra or bladder	1*					1
Opening of venous sinuses						3
Pocketed gland						
Difficulty in cutting or engaging tissue						
Small vesical capacity						
Continual vesical spasm					1	
Total cases with surgical difficulty	6	4	3	7	3	8

\*Urethra

†Bladder

of plasma hemoglobin was between 300 and 400 milligrams in 3 of the 4 cases in which it was between 200 and 300 milligrams, and in 7 of the 14 in which it was between 100 and 200 milligrams. By contrast, the surgeon encountered difficulty during the operation in only 5 of the 26 cases in which the postoperative concentration of plasma hemoglobin was from 26 to 100 milligrams and in 8 of the 44 cases in which it was 25 milligrams or less. Excessive bleeding, opening of venous sinuses, and pocketing of the gland were the difficulties most frequently encountered.

Our investigation of possible postoperative reactions secondary to elevated concentrations of plasma hemoglobin in this series was confined to study of postoperative fever, chills, gastrointestinal complaints, and oliguria. A temperature of 101 degrees F was chosen arbitrarily to represent a fever and only the fever and chill occurring on the first postoperative day were considered in this study because the febrile reaction caused by the accumulation of hemoglobin in plasma is known to appear within a short time after the development of hemoglobinemia. We considered the gastrointestinal symptoms including anorexia, nausea, and vomiting which occurred within the first few postoperative days; our estimation of oliguria was based on volume of urinary output during the first 4 days.

TABLE V — POSTOPERATIVE VALUES OF PLASMA HEMOGLOBIN IN RELATION TO POSTOPERATIVE COMPLICATIONS

Plasma hemoglobin, mgm. per 100 c.c.	Cases	Chill	Fever	Gastrointestinal symptoms	Oliguria
50-100	6			6	
101-200	6			5	
201-300	4			3	
301-400	4			8	
401-500	6			5	
501-600	44			6	1*

\*Not true oliguria syndrome as described in text.

As shown in Table V postoperative chill did not develop in any of the 100 cases. Eleven of the 44 patients who had 25 milligrams of hemoglobin or less had fever while only 6 of the 56 patients who had hemoglobinemia above this level had such fever. This comparison appears to show that concentrations of plasma hemoglobin found in this series do not cause postoperative fever and chill. On the other hand the column of this table devoted to the incidence of gastrointestinal symptoms following transurethral resections shows that these symptoms occur more frequently in cases in which the postoperative level of plasma hemoglobin is high. For example in more than 80 per cent of those cases in which the concentration of plasma hemoglobin was between 200 and 1,000 milligrams per 100 cubic centimeters postoperative anorexia, nausea, and vomiting occurred as compared with 37 per cent of those cases in which the level of plasma hemoglobin was 25 milligrams or less.

None of the patients in this series developed the oliguria syndrome regardless of the postoperative level of plasma hemoglobin. There was 1 death in this series and although the urinary output was low in this case it obviously did not fall into the group of cases in which the oliguria syndrome as previously described occurred. This patient was a white man 77 years old who had arteriosclerotic heart disease, auricular fibrillation and rheumatoid polyarthritis, in addition to obstruction at the vesical neck. Risk of operation was considered great, but after 40 days of preparation, transurethral prostatic resection

TABLE VI.—URINARY OUTPUT OF 6 PATIENTS WHO HAD HIGH POSTOPERATIVE VALUES OF PLASMA HEMOGLOBIN

Patient	Plasma hemoglobin, mgm per 100	Daily urinary output on 1 postoperative days			
		1st	2nd	3d	Average
793	2,300	2,300	2,415	2,400	2,372
864	2,800	2,800	700	90	1,490
1,030	2,000	2,000	2,000	2,000	2,000
115	90	90	200	300	2,000
	2,000	2,000	2,100	2,500	2,150
6	255	125	100	200	1,715

was performed. A diagnosis of contracture of the vesical neck, multiple prostatic calculi and chronic prostatic abscess was made at that time. During resection an old prostatic abscess was unroofed and a total of 2 grams of tissue was removed. The postoperative value of plasma hemoglobin was less than 25 milligrams per 100 cubic centimeters. The patient failed to respond well immediately after operation cardiac decompensation and progressive renal insufficiency manifested by oliguria and uremia developed. The patient died from a high fever apparently caused by terminal bronchopneumonia 5 days after operation. Permission for necropsy was not granted. It was our impression that the oliguria was secondary to cardiovascular collapse.

The daily urinary output for the immediate postoperative days in those patients in whom the value of plasma hemoglobin was more than 500 milligrams is given in Table VI.

Studies of serum bilirubin were performed postoperatively in a small number of cases in which the higher levels of plasma hemoglobin were present. As expected the van den Bergh reaction was indirect in each and the concentration of serum bilirubin was mildly elevated.

#### COMMENT

The incidence of hemolysis following transurethral resection in this series (56 per cent) compares favorably with that in similar series reported by others. Creevy found postoperative hemolysis in 19 of 27 cases (70 per cent) in which water was employed for irrigation at the time of resection. Landsteiner and Finch also reported hemolysis after 10 of 15 trans-

urethral prostatic resections (66 per cent). Undoubtedly if our criterion for hemolysis had been a concentration of hemoglobin of more than 5 milligrams per 100 cubic centimeters of plasma instead of 25 milligrams our results would approximate those of others even more closely.

We have shown that the operative loss of blood, the weight of tissue removed and the technical difficulty of resection all tend to be greater in cases in which the postoperative concentration of plasma hemoglobin is increased. Creevy has shown that irrigating fluid composed of 4 per cent glucose may wash into the blood stream during resection to such an extent that the postoperative level of blood sugar may rise to more than 1,000 milligrams per 100 cubic centimeters. Similarly Landsteiner and Finch labeled irrigating fluid used during transurethral resection with known quantities of sodium salicylate. They found a high concentration of sodium salicylate in the blood of a patient who also had a high concentration of plasma hemoglobin after resection and calculated that about 1,000 cubic centimeters of irrigating solution had washed into the blood stream during the procedure. That distilled water may cause hemolysis when injected intravenously has been shown by Krumbhaar on dogs and by Landsteiner and Finch on human beings. Therefore it is reasonable to assume that when large amounts of tissue are resected when excessive bleeding occurs, or when the resection is difficult large amounts of irrigating fluid may wash into the circulation through venous anastomoses in the prostatic bed and may induce hemolysis.

Our study of postoperative reactions secondary to accumulation of plasma hemoglobin following transurethral prostatic resection appears to show that gastrointestinal complaints are more frequent in patients with hemolysis. Of the patients with concentrations of hemoglobin of more than 200 milligrams per 100 cubic centimeters of plasma, approximately 85 per cent complained of postoperative nausea, vomiting or anorexia, whereas approximately 45 per cent of those with concentrations of less than 100 milligrams had such complaints. In other words, postoperative gastrointestinal symptoms occurred twice as

frequently 10 patients with high concentrations of plasma hemoglobin as in those with no significant hemolysis. Such a result coincides with observations made after the experimental injection of hemoglobin into human beings.

The results from our study of postoperative fever and chills are not consistent with past observations. The experimental injection of large doses of hemoglobin into human beings apparently causes fever and chill at times. Also the febrile reaction accompanying such clinical syndromes as the hemolytic reaction following transfusion with incompatible blood is well known. Yet we found chills in neither the group of cases with hemolysis nor in the cases without hemolysis and fever occurred in a higher percentage of cases without hemolysis than in those with significant hemolysis. The many factors causing febrile reactions following transurethral prostatic resection undoubtedly account for this discrepancy.

The patient in this series who had postoperative oliguria did not have significant hemoglobinemia following resection. This does not prove that hemoglobinemia does not induce oliguria. It has been stated previously that postoperative oliguria is based on many factors of which hemoglobinemia may be only one. Actually the levels of plasma hemoglobin reported in the literature to induce renal insufficiency are higher than the concentrations in the cases in our series. In dogs Flink injected sufficient hemoglobin to produce concentrations of at least 3,700 milligrams of hemoglobin per 100 cubic centimeters of plasma before renal insufficiency developed. In human beings there is evidence to indicate that the same high levels of plasma hemoglobin are necessary before renal insufficiency develops. Comparison is difficult however because many of the published reports concerning the development of renal insufficiency following hemoglobinuria either fail to give the level of plasma hemoglobin at its height prior to the onset of oliguria or do not mention the time interval between the onset of hemoglobinuria and the determination of plasma hemoglobin. We have previously stated that hemoglobin is rapidly removed from the blood stream yet Altschule and Gilligan found the plasma hemoglobin to be 500 milligrams per 100 cubic

centimeters 24 hours after the onset of hemoglobinuria in a patient in whom the concentration of nonprotein nitrogen rose to 90 milligrams per 100 cubic centimeters of blood but who recovered. Fox and Ottenberg described 4 cases of hemolytic anemia and hemoglobinuria due to sulfonamides in which the hemoglobin content of the plasma ranged from 400 to 1,700 milligrams per 100 cubic centimeters. Two patients died from renal insufficiency but the time interval between onset of hemolysis and determination of the level of plasma hemoglobin varied between 12 and 48 hours. Fairley and Bromfield observed 3 patients who died of anuria from blackwater fever; the concentrations of plasma hemoglobin were 3,600, 4,610 and 5,140 milligrams per 100 cubic centimeters. By way of contrast with these figures only 6 of the 100 patients in our series had more than 500 milligrams of hemoglobin per 100 cubic centimeters of plasma immediately after resection of these 1 had a level of approximately 1,000 milligrams. This could indicate that concentrations of plasma hemoglobin commonly attained during transurethral prostatic resection are not sufficiently high to cause renal insufficiency. However Creery has advanced the opinion that in order to produce renal insufficiency in elderly men who have lost blood while under anesthesia high values of plasma hemoglobin may not be necessary.

#### SUMMARY AND CONCLUSIONS

Some fundamental concepts of hemoglobinemia and hemoglobinuria were reviewed to interpret the results of a study of plasma hemoglobin in 100 cases of transurethral prostatic resection performed at the Mayo Clinic.

The incidence of hemoglobinemia following transurethral resection in this series was 56 per cent. This incidence is somewhat lower than that previously reported perhaps because our criterion for hemoglobinemia was based on a higher concentration of plasma hemoglobin than others have employed. Factors during resection which accompanied or may have predisposed to postresection hemoglobinemia in this series were the weight of tissue resected, volume of operative blood lost and the difficulty of resection.

Postoperative gastrointestinal symptoms were more common among those patients of this series who had high concentrations of plasma hemoglobin than among those who did not have any hemolysis. Hemolysis did not appear to increase the incidence of postoperative fever and chills in this series.

Concentrations of plasma hemoglobin per se commonly attained during transurethral prostatic resection usually are not sufficiently high to produce anuria.

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## PHYSIOLOGIC METHODS IN THE DIAGNOSIS OF CONGENITAL HEART DISEASE

THE introduction of surgical procedures for the correction of congenital malformations of the heart and great vessels by Blalock, Craford and Gross and their associates has placed emphasis on the correct preoperative diagnosis of these lesions. A great many of these malformations can be correctly diagnosed by fluoroscopic and physical examination. In borderline cases however more elaborate procedures are necessary. These include visualization of the heart and great vessels with radio-opaque material (angiocardiography) and physiological procedures.

The most useful physiological studies are catheterization of the heart, measurement of pulmonary capillary flow, a standard exercise test and oximetry.

Venous catheterization of the heart is of particular value. The fullest amount of information is obtained if three criteria are fol-

lowed: (1) The position of the catheter should be closely followed under the fluoroscope. (2) Blood samples and pressures should be obtained by means of the catheter from the cardiac cavities from blood vessels coursing to and from the heart and from a peripheral artery. The oxygen content of these samples should be determined. Pressures should be recorded with differential manometers. The measurement of mean pressures with saline or mercury manometers does not give sufficient information, since the height of the diastolic pressure is frequently of particular diagnostic importance. (3) The volume of blood flowing through the pulmonary artery (pulmonary artery flow), the intracardiac shunt and the systemic vessels (systemic blood flow) should be calculated by the Fick principle from the oxygen content of the blood samples. The main diagnostic value of these calculations lies in the recognition of reduced pulmonary artery flow and in the estimation of the volume and the direction of the intracardiac shunt. Of particular importance is the calculation of the effective pulmonary blood flow. This represents the amount of mixed venous blood which reaches the pulmonary alveoli. The ratio of the effective pulmonary blood flow to the total systemic flow determines the degree of oxygen saturation in arterial blood. The Blalock-Taussig operation is beneficial because this ratio is increased through the construction of an artificial ductus.

In the surgical laboratory of the Johns Hopkins Hospital catheterization of the heart has now been performed on approximately eight hundred individuals with congenital heart disease. In five of these air emboli to the brain occurred during the catheterization.



However all symptoms disappeared within 24 hours and there was no residual damage.

The pulmonary capillary flow is determined by a method involving the equilibration of carbon dioxide with pulmonary capillary blood, the sampling of carbon dioxide content in alveolar air and the determination of carbon dioxide production. While sampling of pulmonary artery blood permits the calculation of the pulmonary artery flow only the carbon dioxide equilibration method measures the total amount of blood perfusing the lungs (pulmonary capillary flow). By comparing pulmonary artery with pulmonary capillary flow the flow through the collateral vessels or through an artificial or congenital ductus arteriosus may be estimated.

The standard exercise test compares the ratios of the oxygen consumption to respiratory minute volume during a standard exercise test and at rest. Normally the oxygen consumed per liters of ventilation increases from rest to exercise. In conditions in which pulmonary flow is fixed (e.g. pulmonary stenosis) this ratio usually declines. The test is easily performed and requires no special preparation.

The oximeter is an instrument which measures the oxygen saturation in peripheral arterial blood by means of a photoelectric cell attached to the pinna of the ear. The original Millikan instrument has been greatly improved by the more accurate models designed by Woods and Geraci and by R. T. Cox. The newer models permit the measurement of the arterial oxygen saturation within 5 per cent accuracy. The fact that the peripheral oxygen saturation falls during exercise in the presence of a venous arterial shunt can be demonstrated with great ease by oximetry. This is usually carried out simultaneously with the standard exercise test. Furthermore, the oximeter is useful in differentiating anoxemia due to ve-

nous-arterial shunts from arterial unsaturation due to oxygen transfer difficulties resulting from pulmonary disease. In the latter case the oxygen saturation rises within one minute to full saturation when 100 per cent oxygen is inhaled. In the presence of a venous-arterial shunt on the other hand the rise in oxygen saturation will extend over several minutes and full arterial oxygen saturation is rarely obtained.

The results of these tests in tetralogy of Fallot show a decrease in pulmonary artery flow, an intracardiac shunt predominantly directed from right to left and usually evidence of marked collateral circulation to the lung. The systolic pressure in the right ventricle is significantly elevated above that in the pulmonary artery. The exercise test shows a fall in the oxygen consumed per liters of ventilation and a decline in the peripheral arterial oxygen saturation. On the breathing of pure oxygen the peripheral arterial oxygen saturation rises over a period of several minutes and full saturation is not reached.

In Eisenmenger's complex and in a great majority of auricular or ventricular septal defects the pulmonary artery pressure is elevated. This is probably the result of arteriolar changes in the pulmonary vessels. As a result of the increased resistance in the pulmonary vascular bed the overall direction of the intracardiac shunt may be from right to left.

Elevation of the pulmonary artery pressure due to increased resistance in the pulmonary bed is also frequently encountered in auricular or ventricular septal defects. In the presence of an auricular septal defect the oxygen content of right auricular blood exceeds that of vena caval blood. With a ventricular septal defect the oxygen content of right ventricular blood exceeds that of right auricular blood. During the standard exercise test the oxygen consumed per liters of ventilation usually in-

creases and the oxygen saturation of peripheral arterial blood falls

Recent advances in the surgical treatment of transposition of the great vessels by Blalock and his associates have focused the interest of pediatricians and surgeons on this malformation. The intracardiac hemodynamics in transposition of the great vessels differ from those described for the tetralogy of Fallot and related conditions. In transposition the pulmonary arterial blood flows from the left ventricle through the lungs into the left auricle while the systemic blood courses from the right ventricle into the aorta through the systemic circulation and back into the right auricle. If this malformation is to be compatible with life, oxygenated blood must reach the aorta either through a septal defect or a patent ductus arteriosus. However, the volume of oxygenated blood shunted into the systemic circulation must be balanced by an equal volume of unsaturated blood entering the pulmonary circulation, since a unilateral shunt would lead rapidly to a diminishing blood volume in either the pulmonary or the systemic circulation. The volume of the shunted blood in either direction equals the effective pulmonary blood flow. The practical importance of these considerations lies in the fact that any surgical correction of transposition which involves the creation of a unilateral shunt must be balanced by an equal and opposite shunt.

In patent ductus arteriosus the blood oxygen content in the pulmonary artery exceeds that in the right ventricle. The blood pressure in the pulmonary artery may be normal or slightly elevated. The oxygen consumed per liters of ventilation and the oxygen saturation in peripheral arterial blood remain constant during the standard exercise test.

The physiological procedures described are of particular value in the recognition of diminished pulmonary artery flow and of de-

creased or increased pulmonary arterial pressures. In most instances they are helpful in identifying and locating intracardiac or extracardiac shunts. Furthermore, changes in hemodynamics produced by operative procedures can be quantitatively evaluated. As the field of cardiac surgery expands into the realm of acquired heart disease, physiological studies will be of increasing importance in supplying the surgeon with essential criteria for operative intervention.

RICHARD J. BING

## EXSTROPHY OF THE BLADDER

EXSTROPHY of the bladder is one of the rare congenital anomalies occurring once in 40,000 births, which is amenable to surgical treatment, but the fact that there have been about seventy different surgical procedures described for its correction indicates that there must be many points of interest about the technique and results of the surgical methods which remain unsatisfactory.

The optimal time for operation is one of the points for discussion. When one considers that from a statistical point of view half of these patients are dead by their tenth year and two-thirds are dead by their twentieth year, it simply indicates that whatever is done for them must be carried out before adolescence and more particularly before the tenth year. In recent years it has been recommended that these operations be done during the first twelve months of the patient's life under the supposition that an infant tolerates trauma unusually well and that the anomaly should be corrected before any recurrent renal infection develops. In evaluating this point one should remember that perhaps it is better to delay until the patient has learned bowel control. Also this condition is not considered a surgical emergency as is pyloric stenosis, tracheobronchial fistula, strangulated umbili-

cal hernias, and so forth so that one can conceivably wait until the fourth or fifth year when the anatomic structures are larger and anastomosis can be more satisfactorily and accurately done. The preparation of the bowel for ureterosigmoidal anastomosis can also be done more easily and completely. Since the results depend almost entirely on the character of the anastomosis, these structures should be of such size as will enable one to approximate them accurately without tension. I doubt if these conditions which are so vital to the conduct of the operation and to the future health of the patient are present before the patient is five years of age.

Bilateral ureterosigmoidal anastomosis and cystectomy are regarded as the proper procedure for surgical correction of exstrophy of the bladder to be followed by any plastic procedures which may be required on the external genitalia of either sex. Whether this ureteral transplantation should be done in one stage or two stages has been a matter of considerable debate. The decision depends it would seem on the type of anastomosis which is used and on the fact that antibiotics and penicillin are available in the preparation of the sigmoid and for the prevention of postoperative infection of the urinary tract. In earlier years a two stage operation either extraperitoneal or intraperitoneal was generally regarded as the proper procedure. More recently with improvement in the technical procedures of the anastomosis and in preparation of the bowel the one stage operation is favored.

The object of the operation is to secure an adequate urinary sinus between each ureter and the sigmoid without subsequent ureteral obstruction or retrograde contamination of the upper part of the urinary tract. It is on account of these two factors particularly that many operations have been devised direct to the improvement of the ureterosigmoidal

anastomosis. Obviously the anastomosis can be more perfectly and accurately accomplished by the transperitoneal approach because to carry out this procedure it is vital that the sigmoid be accurately placed adjacent to the ureter on each side and that the ureter be placed in the bowel without tension and without fixation. When tension and fixation of the ureter occur at the point of union to the bowel there will be interference with its delicate blood supply and the incidence of ureteral fistula increases. Also the rhythmic contraction of the ureter for the proper expulsion of the urine into the bowel will not be normal and there will be subsequent obstruction and ureteral dilatation with infection of the urinary tract. Under these circumstances then the most favorable situation is where the ureter is placed within the bowel devoid of any sutures catheters or guides. This can be accomplished by the standard Coffey Mayo technique with these exceptions the ureter is gently pulled into the bowel for a distance of 3 to 4 centimeters and is held firmly until the bowel can be fixed to the parietal peritoneum for a distance of at least 4 centimeters above and below the point where the ureter enters the wall of the sigmoid. The bowel is fixed firmly to the peritoneum so that the ureter goes directly into the bowel without tension or any fixation. The peritoneum if properly placed with relation to the bowel will close any defect to the bowel within a few hours and will prevent any leakage of urine or intestinal contents.

Patients who have practically normal pyelograms and ureterograms within a few months subsequent to transplantation rarely have any attacks of infection of the upper part of the urinary tract a fact which must indicate that the surgical procedure which was utilized approached at least the desired requirements. Further evidence that delayed urinary complications are directly attributable to the character of the anastomosis is shown by the fact that if a kidney becomes functionless the left one is involved three times more commonly than the right kidney and the correct application of the sigmoid to the peritoneum on the left side without tension on the ureter is three times more difficult to accomplish than on the right side.

Obviously then the surgical problem in managing exstrophy of the bladder is to select the favorable time for surgical intervention to give strict attention to securing a uretero-sigmoidal anastomosis without tension or fixation of the ureter and to require periodic studies of the upper part of the urinary tract of the postoperative patients for from three to five years.

If in a few months or years ureteral obstruction appears and becomes progressive with a gradual loss of renal function permanent nephrostomy or ureterostomy is the operation of choice and will add a number of years to the patient's life expectancy.

A good functioning skin ureterostomy is more serviceable to the patient than a nephrostomy because the patient can change the catheters himself when necessary and can adjust them to the proper level within the renal pelvis to obtain efficient drainage. A catheter which does not extend to the renal pelvis will have urine leaking around it.

Good skin ureterostomies are difficult to produce and this procedure should not be

undertaken by anyone who is not familiar with the conditions which may arise that will cause complete failure of the operation such as sloughing and retraction of the end of the ureter below the abdominal wall pressure from the catheter or an abscess in the wall of the ureter may produce a ureteral fistula thereby ruining the operation.

A nephrostomy is a less complicated procedure and can be done subsequently if a skin ureterostomy has for any reason been a failure. It is more troublesome to the patient because some one must change the nephrostomy tubes and dress the area for him. A nephrostomy is practically a defect proof operation and can be performed by most surgeons interested in this field of surgery. Even so I feel it should be emphasized that to secure a good functioning nephrostomy it should be so placed that it goes directly down from the skin surface through the kidney and into its pelvis. Should the pelvis be a bifid one or should there be a complete duplication then double nephrostomies may be necessary but such information must be available before the operation is begun.

These two surgical procedures should be considered as a reserve which may be utilized subsequently to prolong the life and comfort of patients if for any reason the ureterosigmoidostomy has become defective with consequent destruction of renal tissue and function.

The use of antibiotics and penicillin during preparation for and subsequently to surgical treatment will increase life expectancy to a considerable degree. Certainly the future for these patients is promising especially when one considers that without these drugs 50 per cent of patients were alive twenty five to thirty years after operation.

VIRGIL S. COUNSELLER

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When one reviews the deaths after ureterosigmoidostomy for exstrophy it is noted that 50 per cent of the deaths in the hospital are due to pyelonephritis, ureteritis with or without gangrene and peritonitis and that uremia and pyelonephritis with stones or hydronephrosis or both account for 65 per cent of the deaths after the patients leave the hospital.

# THE SURGEON'S LIBRARY

## THE BOOK SHELF

### THE GENTLEMAN FROM TENNESSEE

FRANCES TOMLINSON GARDNER, San Francisco, California

**A**NDREW JACKSON is a legend. His political career, his army life, and his domestic career have been explored as thoroughly as the personal affairs of Hamlet's father. His biographers, although they have meticulously recorded all these things, have touched on the subject of his health and physique with the small interest of casual reporters. Andrew Jackson was made of the usual blood and bone but the one was thin and the other fragile. No structure ever endured under greater handicaps than the frame that supported the brain of the astonishingly determined, the invincible gentleman from Tennessee.

He was normally born to sturdy pioneer parents in the Waxhaws Settlement of North Carolina in March 1767. His father was recently dead of an injury resulting from trying to lift a fallen tree single handed. His energetic mother died of typhus when Andrew was fifteen. His two brothers were robust and died of causes unrelated to heredity. In Andy's early youth his only recorded skirmish with disease was an attack of something called "The Big Itch" of which it was said that it itched one very much all over.

His small taste of the Revolutionary War ended in his capture by the British who imprisoned the boy and his brother Robert in a blockhouse near Camden. Due to a refusal to black the boots of a demanding British officer Andrew received the saber cuts on wrist and temple which were still prominent when the old man died sixty-four years later. Hidden but of far deeper significance was the rancor which settled in the inner Jackson and which colored every thought and action toward the British most of the days of his life.

Still in bandages from the assault, he as well as his brother caught the smallpox which swept the unhygienic quarters in which they were housed. News of the epidemic reached Mrs. Jackson and he came to prevail upon the British to release the

presumably dying children to her custody so that he could take them home to nurse them. The British gladly consented since for them it meant two invalids less and Mrs. Jackson loaded Robert the sickler of the two on her only available horse Andrew horseless and hardly less ill walked the entire forty miles back to the cabin in the Waxhaws. Robert did not live to get home and Andrew soaked by a pouring rain and with his smallpox driven in arrived in a raging fever and delirium. To everyone's surprise he eventually recovered and no one paid much attention to the long siege of fever and ague which he endured after the disease had subsided. From this time began the underscoring of low fever, intermittent fever or fever which was seldom absent from Jackson's own mention of his health. In the fastnesses of North Carolina malaria was endemic. Who was he to escape?

At fifteen he was long, skinny and sallow. His manners were bad and his language deplorable. While he was at school though he was as thin as a pencil and as fragile as a pipestem he would fight at the drop of an epithet anyone who had the misfortune to annoy him. He seldom won since everybody else was stronger and heavier but it was not important to him. Nor was it important that the same boy might have beaten him unmercifully the day before. He learned very young that offense was his best defense and through it he did manage at considerable physical expense to keep at a minimum unkind comment about his embarrassing physical defect. It must be admitted that from infancy to manhood poor Andrew was a drooler. The condition was bad enough when he was calm but when he became excited it was gushingly profuse. Since he could not swallow fast enough to dispose of the quantities of saliva with which his overactive parasympathetic nervous system afflicted him he could only defend his right to it. Since it was a vicious circle he spent much of his time in a sort of frenetic bell-

From Department of Medical History and Biographical Research, University of California, School of Medicine



Andrew Jackson, 1767-1845

*The Gentleman of Tennessee — Frances T. Milson Gardner*

Photograph of bust of Andrew Jackson modelled from life by John Frazee. Courtesy Art Museum, Princeton University

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The fortunate demise of a rich uncle in Carrickfergus, Ireland put the gangling adolescent in possession of several hundred pounds. With these he bought himself a horse and some good clothes and set off to improve his education and neck his fortune. After a short stay in Charlotte he descended with a flourish upon Salisbury where he cut a handsome swath. He was developing what his detractors, in these and later years, called his other manners—the polished ones. In pursuing the polish he left his money far behind and after a year departed from Salisbury financially a ruin.

This short study of money and manners convinced Andrew that success would crown only greater effort and real concentration. He abandoned his wild oats in midfield and, after two years of determined study, paused his examinations and became prosecutor in the court of Judge John McNairy in Nashville. He was only twenty-one which would seem callow for a prosecutor had it not been that the Judge was only twenty-six. Andrew's courtroom manner was still a moderately adult application of his childhood aggressiveness, but since it was usually backed by evidence, it began to help instead of hinder.

Andrew boarded with the family of John Donelson where he met Rachel Donelson Robards, estranged from her disagreeable husband and living in her father's house. The love of Andrew and Rachel was a crucial factor for it like the inner damage inflicted by the attack of the British officer colored every action of his life thereafter. In this woman's defense he received wounds which determined the course of his health and, because of her, he nearly failed to win the presidency.

Robards, drunk but determined, used threats and ruses to force the return of his wife. None of the moments of best romantic tradition were slighted in the course of the affair. In 1790, worn out by the struggle, Rachel did return to her begging husband but found life so unendurable that she sent for someone to come and take her away again. Her family sent Jackson. Like the knight in shining armor he swept her away to her sister. It was an innocent voyage of desperation but it might as well have been the blackest of elopements. Rachel's reputation tottered.

Robards declared that he would sue for divorce immediately and, presumably, went off to do so. Hearing no more, Jackson and Rachel waited a proper length of time and then in 1791 were quietly married. It is odd that Jackson, with his legal training, did not bother to make sure that all obstacles had been removed and that Rachel was a free if sullied character. He made a grave mis-

take because Rachel was not free. Her disgruntled and cunning husband had never divorced her at all. He had only gone so far as to procure an "enabling act" which gave him the right to petition, but was nothing more in itself. So, to the crime of having run away with another man's wife, Andrew Jackson added the sin of living with her for three years without benefit of marriage. In 1794 Robards tired of the game and put the divorce through. By this time our red-headed friend had become so stubborn and righteous that he had to be strongly persuaded that, for the benefit of anything that remained of Rachel's reputation, it was necessary to remarry her. After much display of Jacksonian temper and some speeches about the eyes of God, the pair went through another ceremony. Unfortunately by this time, no act of his could repair the damage to Rachel's good name. For thirty-seven years her husband defended her valiantly but hopelessly. In honor of what he called "The Sacred Name" he used whips, fists, and pistols on calumniators but he was never able to restore her to respectability. When he was made president the poor little woman did her best to prepare for what must have loomed to her as a hideous and endless ordeal. By the grace of some kind of Providence on the eve of her departure for Washington, a final heart attack stepped in, and Jackson entered the White House a widower.

In 1806 ill feeling of some years standing came to a climax when Charles Dickinson publicly slandered the name of Rachel Jackson. The conduct of the resulting duel has been discussed acrimoniously for the past hundred and forty-two years, not always to the credit of Jackson, the survivor. He appeared on the field in an enormous black overcoat, which he did not remove. He was so thin that the bulk of the coat effectively disguised all the landmarks by which a duellist works and Mr. Jackson's heart was not where Mr. Dickinson had every reason to believe it belonged. Consequently the well-aimed bullet went wide of the mark, tore the chest muscles, broke a rib or two and settled in the chest cavity where it remained the rest of Jackson's life. Dickinson having shot, was thus disarmed and forced by honor to stand still while Jackson, bleeding but not dead as he should be, took careful aim and shot him in the stomach. Dickinson died in agony some hours later. Jackson, after some histrionic nonchalance about his injuries, finally allowed himself to be examined and put to bed. It was then found that the wound was more severe than he had thought. He was more than a month in getting around again.

Through the years until 1813 when he was forty-six run these recurrent complaints growing gradually more frequent "I have had a severe attack of fever a cold with pain in the breast and a cough" Severe attack of dysentery serious intermittent fever and by the turn of the century rheumatism especially in the right arm. He was over well but in his own opinion he was never very ill. These were his years of growth politically militarily and in his private life. A twentieth century man faced with the symptoms which were beginning to appear in Andrew Jackson would withdraw from the world and retire with misgivings to a little white cot in the sun but Jackson lived with different opinions about health and in a glorious ignorance.

Several of his biographers including Parton claim that the effects of the Dickinson duel were largely responsible for the death of the old gentleman thirty nine years later. Inasmuch as the bullet lay within his chest cavity during all these years and since the picture of his final dissolution is not one of terminal tuberculosis at all but of a combination of other things, they were right in a sense though wrong in their major premise which was to the effect that the bullet agitated into flame the latent tuberculosis in the Jackson chest. It is doubtful on the contrary if Jackson ever had tuberculosis at all. True he had occasionally complained of cough and a pain in his chest but always after serious exposure as when he appeared at a midnight fire on a cold wet night without his coat or shirt. A homely diagnosis of bronchitis sounds appropriate here. The recurrent fever is accounted for by his malaria and his dysentery by the ubiquitous ameba or bacillus. The emaciation and poor color would hardly be unexpected in a body struggling against all these afflictions.

Parton claims that a fall in 1825 tore open the wound of the Dickinson duel and re-established the process of degeneration. This statement presupposes that in the interval there had been an improvement. This was not true. There was only a slow but definite decline. It is true that in 1825 Jackson did fall heavily and that the immediate consequence was profuse pulmonary hemorrhage but Parton and the others in their preoccupation with the Dickinson duel neglect to weigh other factors which became evident during the intervening years. By 1825 the sting of a bee was enough to upset the invalid.

When the bullet entered his thoracic cage and lodged there it carried with it bits of cloth dust particles and other foreign matter. Just where the bullet went is a moot question for there was no x ray machine. Perhaps it lay beside his heart

perhaps it impinged on his left lung. Whatever it did it immediately set up an inflammatory process and promoted an abscess nearby. Meanwhile the torn musculature of the shoulder predisposed the bruised underlying tissue to infection. There is every inducement and no deterrent to the formation of a pulmonary abscess.

In the early years of the nineteenth century with its incomplete knowledge of respiratory disease nearly anything which produced cough sputum bleeding and wasting was tuberculosis. The great strides of the nineteenth century were barely beginning and the complicated reaction of the body tissue to disease superimposed upon disease was far beyond the most informed of contemporary physicians. Jackson developed all the classic signs of tuberculosis, ergo he was tuberculous. This was excellent reasoning but it did not go far enough. In all probability the man was becoming the victim of a series of unlucky illnesses any of which was formidable and which all together unhealed and unintelligently treated lead inevitably to that dogged murderous follower of long standing suppuration—amyloid disease.

In 1813 through the unfortunate championship of the wrong man in another duel Jackson became involved in what developed into a tavern brawl. His one-time good friends Thomas and Jesse Benton and assorted other people met with Jackson and his friends and indulged in a battle which involved fists clubs and pistols. Jackson was shot twice by Jesse Benton once in the already damaged left shoulder and again just below it in the left arm. There was no sauntering around this time. The weak shoulder was shattered and the second bullet did not emerge from the arm. It lay against the bone in the heavy muscle and it had like its predecessor in the chest introduced its contribution of cloth and dust particles. The hemorrhage was so massive that two mattresses belonging to the Nashville Inn were rendered useless for any future guest before it could be brought under control. Surrounded by all the doctors in Nashville all but one of whom urged amputation Jackson whispered "I'll keep the arm." He allowed poulticing with slippery elm and transplanted to the Hermitage he stayed in bed for three weeks simply because he was too weak to get up. This was not the end of that wound. The arm was in a sling for six months. Never until the bullet was removed nineteen years later did the inflammation subside. During all this time an active osteomyelitis was in progress.

While he lay coughing and sweating and aching the affairs of the nation went on. The Creek In

hians rose in revolt. When the report was brought to Nashville it had the anticipated effect upon the prostrate warrior. With undeniable heroism and appalling fortitude he hauled himself on his horse and went off to subdue the rebels. He could have been little better than a bedridden ruin. His shoulder was unhealed, his arm was useless and his temperature must have been mortifying since he was also in the muddle of a severe attack of dysentery. Dr. Frederick May, who accompanied him, was asked on his return how the general had survived the trip. Dr. May's interesting but somewhat cryptic reply was that they had had to stop frequently and wash the general all over with sugar of lead to keep down the inflammation.

Sugar of lead believed at the time to have some peculiar antiphlogistic action beyond its simple astringent powers, was Jackson's great support. He used it not only internally for his supposed tuberculosis and his chronically queasy stomach but externally for anything that bothered him. He even used it as an eye wash when his sight began to fail. Since his specific for his dysentery was calomel, which he took in massive doses it raises the question whether after years of constant use some of his various life efforts might not have been increased by a touch of lead or mercury poisoning. The only other drug that he would counteract was common salt for emergency use in pulmonary hemorrhage which he backed up with the free and effective use of the lancet.

Within a few days of his war arrival was fought the battle of Tellico. One of the critical battles of the Creek War. Jackson was so ill that he could neither lie comfortably nor sit. During the paroxysms of his dysentery he propped himself in some strange manner over two poles, from which he hung hour after hour. This brings up an interesting point since a shoulder badly wounded as his recently had been would not have been in much of a condition to use as a support. By what portion of his anatomy was Jackson for several days supported? To his misery was added the lack of food since a complete breakdown of the service of supply had thrown the army on the scrawny resources of an empty terrain. Jackson, racked with dysentery, subsisted on raw acorns and some of the entrails of an unfortunate hog.

Incredible man. Through the whole of this campaign and that which followed and ended with the Battle of New Orleans, his suffering and his endurance were beyond belief. In Mobile the wounded arm sloughed a piece of necrosed bone which he lovingly sent to Rachel. There was hardly a moment when he was not racked with fever, nauseated and in harsh pain. Yet if ne-

cessity demanded he would descend from the horse on which he seemed barely able to sit and march or fight beside his men until the emergency was over. It was these years which earned him the name "Old Hickory."

He arrived in New Orleans late in 1814, hailed as the country's hero. He had come to defend the city against the British attack which was momentarily expected. The citizens were beside themselves with enthusiasm for him and prepared a welcoming breakfast in the succulent manner of the best creole cooks. When he arrived he was, as usual, just recovering from a serious bout of fever and was gaunt, grey, unshaven, and disheveled. He was also very cranky and his stomach was so squeamish that confronted with all the culinary wonders of New Orleans he ate a table-spoonful of hominy and a little milk. Disappointed to tears, the hostess of the occasion spoke with apertis about the ugly old haintuck flat-boatman who was shuffling around the beautiful floor in his muddy boot. What a catastrophe was the general.

New Orleans was shocked to its suave core but it was game. Its leaders, realizing that battles were not won with company manners, gave him the co-operation needed during the days before the battle. Mr. Livingston, a local aide de camp, determined to obey the social amenities in the face of outrage, summoned influential New Orleans to a dinner in his honor. New Orleans came with misgivings, but it came. Unusually it sat awaiting the arrival of its celebrated incubus. The door opened. Surrounded by his aides in marched a slender, bronzed, superbly erect gentleman whose well brushed hair framed a quizzical but smiling—and shaven face. His uniform was pressed and brushed. His high boots gleamed. His sword gleamed as a sword should do. His voice was soft and his conversation impeccable. New Orleans fell at his feet in relieved embarrassment. Now, oh what a joy was the General.

Following the battle of New Orleans the hero was more adored than ever. During the years immediately following his position in the country became such that though he lost the election of 1824 it was plain that he was the man to watch in 1828. His career continued in the presence of constant and progressive ill health which he made no attempt to hide. He was continually up and down though prostration was allowed to interfere with his activities as little as possible. In 1821 his chronic chest condition exacerbated into inflammation of the lungs and in 1822 he was laid out for four months with "violent cough and costiveness." The "costiveness" suddenly reversed

himself and became an excruciating attack of his old dysentery so that, for a time he had as many as twenty passages in twelve hours. During this illness he complained for the first time of very copious sputum. He called it "great quantities of slime." The tortured bronchi had now responded to the perpetual inflammation by the establishment of a characteristic bronchiectasis which assured the patient, though he did not know it, that until the end of his days he would be harassed by "slime" which would be more and more troublesome as the time went on. So innocent was he of the true meaning of all this sputum that he seemed to think that in coughing it up he was disposing of something valuable of himself. He said that he was sure he would be better if "I can moderately check this loss." In 1825 following the fall beloved of his biographers he had one of his more memorable hemorrhages and tore apart the weakly healed shoulder wounded in both duels. There were already many hemorrhages in his history but he had become so hardened to them that, unless one made him especially uncomfortable, he did not always mention it.

His teeth were decaying with great rapidity, perhaps assisted by the calomel as well as by his general health. During the years 1826 to 1828 most of them disappeared and he was fitted with some false ones which he disliked and would not wear. During these years he was cursed with toothache and jaw ache and increasing headache which by 1838 was beginning to affect his vision. The loss of the teeth cleared up the tooth and jaw aches but did nothing for the headache which became like all the other conditions, a part of him.

In this state he won the election of 1828. What an astonishing physical specimen he was to sit in the presidential chair. Sixty-two years old, racked with pain, fainting from weakness, his constituents brought him to Washington at an unpublicized hour to pare him the overenthusiasm of the crowd. Elections being what they were, he could not be entirely secluded and in his rooms at Cadsby a he could be seen and bandshaken by almost anyone. Otherwise he was hidden away and handled like fine china so that he might be well enough to take office on inauguration day. On that day as always he rose to the occasion. Spurning a carriage he walked bareheaded to the White House.

The record of his years as President needs no recapitulation. The two terms stand highlighted by such things as his stands on Nullification, the United States Bank, the National Debt and the Spoils System. Right or wrong they were the

stands of a man of power and strength. His blistering feuds with Clay, Calhoun, and Webster, to name only the most obvious, took more than the average man has to give over a period of years. His occupancy of the White House was accurately known as the Reign of Andrew Jackson and it was accomplished by a tottering scarecrow in deadly agony.

Soon after his inauguration serious changes became evident in his condition. They were not really sudden for it was the old story of the water wearing away the stone, but they were especially to the bewildered clinical innocents of that day dramatic and frightening. The basic septic condition was yielding to even greater sequelae.

Through the spring and summer of 1829 the President a whole system seemed out of sorts. His feet and legs began to swell so that by December they were genuinely dropsical. He complained bitterly of the pain in his chest and his shortness of breath was noticeable to anyone who was in the room with him. His headaches grew excruciating and left him for only a few hours at a time. His vision was very troublesome. He tried a sea bathing holiday and came back to Washington to be felled by fever caused by the miasma arising from a sewer being dug. His stomach was unmanageable. He had fever. In short he had a true nephritis with those nephritic headaches that only a kidney sufferer can understand. There must have been an early cardiac decompensation with a nice rise in blood pressure. His eye grounds had they been seen by a modern practitioner would have caused considerable correspondence between his doctors. Meanwhile of course the pulmonary focus of infection the malaria the dysentery, the osteomyelitis and the bronchiectasis were going on and on and on.

The party pleased with his administration wanted him to run again but their misgivings were very plainly put in a note written to Martin Van Buren by William L. Marcy when the question of the vice-presidency was pressing. Said Mr. Marcy: "Of all the candidates for vice president spoken of there is not one who possesses more than barely sufficient qualities for vice-president. General Jackson is advanced in life and to be frank with you is in feeble health. I must say however I wish otherwise that I think the chances are against his lasting five years longer. With the best of those now spoken of for vice president at our head as chief magistrate we should be in a miserable situation."

Such was his own faith in his indestructibility that the President managed when the Party quieted its fears enough to enlist him to carry out

a campaign which included parades on horse back, grueling field trips, speeches, banquets, and all the other performances required of presidential candidates. It was hampered by hemorrhages, bowel flare-ups, bleedings, cuppings, and colic apices, but he won the second term of 1832.

In January of that year somebody at last persuaded him to allow the removal of the pistol ball from his left arm. His final grudging acquiescence was probably due to the fact that the pain in his chest and side was constant and increasing and he was having serious trouble with his shortness of breath. It is a question why he thought that the excision of the ball from his arm should help, though it was still, as always, inflamed and draining. Nobody mentioned the ever present bullet in his chest. The thin yellow old man stood in his bedroom in the White House, grasped the back of a chair and a doctor cut out the ball. Then, Mr Jackson rolled down his shirt-sleeve and went out to dinner.

The arm healed, for the first time in twenty years, but the loss of the bullet brought no relief to the pain in his chest and side. Jackson called in Dr Philip Syng Physick the greatest of them all. Dr Physick said that cupping would relieve it. Cupping did nothing. Dr Physick declared that the other bullet, lying so close to the President's heart, was of no consequence. Dr Physick was strangely apathetic about the general condition of the patient. He said not a word about the dysentery, the swollen legs, the hemorrhages or the assorted other troubles of the invalid. Probably there were so many symptoms that Dr Physick felt lost in a thick forest of very small trees. Perhaps he felt another sort of helplessness since his patient could not be induced to obey orders. Except for his three specifics, an occasional flier into somebody's patent pain killer and his lancet, Jackson could never be forced to do anything for his health except to lie down when driven by pain or exhaustion.

When his second term of office came to an end and Martin Van Buren was inaugurated, the events of the day must have had an uncanny resemblance to those of the Day of Days of Warren Harding. The wrathlike Jackson, like the shattered Wilson, staggered from his bed to conduct his ruddy, full bodied successor into office before being helped out of the White House into feeble retirement with a doctor on each arm. Jackson left Washington so ill that he was accompanied as far as Wheeling by Dr John Lawson the Surgeon General, and from Wheeling to Nashville by other competent army surgeons who never left his side until they saw him safely into his own bed

at home. It was a journey of three weeks and it seemed quite possible that he would never make it.

Everything was wrong with him. Amyloidosis is not often seen these days of quick relief of inflammation for it is a condition brought about by chronic suppuration. When established it is implacable. It is the only condition which can account for the grisly last years of the patient and miserable sufferer.

After 1834 he seldom had as much as an hour free from pain. His chest, his side his short breath, all contrived to keep him in agony. His stomach refused almost anything except rice and milk. His right eye, by 1837 failed in earnest. He described it as a "white something approaching the sight" and treated it with weak sugar of lead. In 1838 during a crisis of fever and delirium his head and ear swelled to alarming proportions and his head broke out "all over soars" which he thought a very good thing. His shortness of breath precluded any exercise except a few supervised steps around his estate always ending at Rachel's grave. His days were a procession of all his chronic symptoms with a myriad of painful if passing additional ones.

In this shocking state he had the temerity to travel to New Orleans for a celebration in his honor. En route he hemorrhaged so badly that it was many hours before the bleeding could be controlled and when he arrived he was too ill to make more than a token appearance. Yet, when it was over he managed to get to Jackson, Mississippi where he allowed himself to be the reason for more festivities for two days and nights. Then, after ten days in Vicksburg he, somehow got back to the Hermitage and when he arrived remarked, in a pleased way that his health was about the same as it had been before he left.

This was his last long trip. Once or twice thereafter he tried to ride a little but he had to give it up. 1841 and 1842 dragged by with endless days of pain. He gave up trying to eat with the family and subsided into his invalid chair. He thought his left lung completely destroyed. In 1843 he was acutely ill, if more ill he could be, with bilious colic and cholera morbus as though he were not contending with enough without an attack of gastroenteritis. By this time the amyloidosis had reached nearly every organ in his body.

He gave up his little walk to Rachel's grave. By 1844 he could not walk at all. He lost the power of voluntary motion and was lifted from his sitting position in bed to the same position in his chair. His mind was as clear as ever and with what strength he had he insisted on making constant attacks on his still endless correspondence.

His letters show no diminution of the masterful intellect which seemed to be the only part of him decently alive. By 1845 this beautiful mind rested in a body which was nothing more than a decaying mass. In May 1845 he wrote to Andrew Jackson Donelson that "I am swollen from the toes to the crown of my head and in bandages to my hips. I have had a violent bowell complaint which averaged six to eight passages in twenty-four hours with a constant nausea at my stomach. He told Francis Blair at the same time that he was a perfect mass of jelly from his toes to the upper part of his abdomen. The distended flesh of his dropsical legs had probably broken down thus necessitating the bandaging. The dysentery and the nausea a thousand times exacerbated by the progress of the amyloidosis gave him no respite. Then as the ultimate of cruelty the poor old man had hemorrhoids.

At this very late date a painter was sent from France to make a portrait of the old hero. It was very late. The edema had become so pronounced that the artist could use only the brow and the bushy white head and was forced to take the rest of the face from a painting made several years earlier. It was an agony for the patient to sit for his portrait at all.

The end was at hand. On June 1845 his belly had become so distended that Dr. Foxelman of Nashville came hurriedly to tap him. It was a useless effort for the relief was negligible and the patient was exhausted. He sat miserably propped up in bed, unable to lie down. He could not eat.

He could not die. Under opiates for his pain he drifted in and out of consciousness until Sunday, June 8th. All that day he was moribund until suddenly at sunset he opened his eyes. His last act was to ask whether he could recognize

him to which he answered tartly that of course he could and that he would recognize the others around his bed if someone would kindly fetch his glasses. When they were brought he wiped them neatly on the sheet and perched them on his nose. There was a sentence or two a sigh and a feeble chuckle. He was gone as though all at once. He had decided he had fought too long.

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## REVIEWS OF NEW BOOKS

THE second edition of Dr Mettler's *Neuroanatomy*<sup>1</sup> is an improvement over the first edition, which was published in 1912. Not only have many of the minor errors been corrected but the author has added a number of new and noteworthy illustrations. One of the principal features of merit is the incorporation in a textbook of neuroanatomy of illustrations and descriptive material for the gross anatomy of the cranium and especially the blood vessels therein. Functional and clinical aspects of the subject have been woven into the fabric of the book and make it especially useful for the advanced reader. On the other hand, the inclusion of much detailed and some controversial material detracts from its usefulness as a textbook for beginning students of medicine.

WILLIAM F. WOODWARD

THE monograph, *Strabismus, a Clinical Handbook*<sup>2</sup> directed primarily to the ophthalmologist deals with the practical clinical methods of examination, diagnosis, and treatment of strabismus. It is not a large book since it contains only 204 pages with 76 plates and drawings.

The book is separated into six chapters divided according to anatomy, physiology of binocular vision, normal muscle balance, concomitant strabismus, paralytic strabismus, and strabismus surgery.

Considerable attention has been given to the significant contributions of Sherrington in the physiology of binocular perception and Chavasse in the development and mechanism of normal and abnormal binocular reflexes, in the hope that more effort will be diverted toward clinical and laboratory study with less emphasis on abstract speculation.

The book contains an outlined method of procedure for working up the patient with concise instructions as to the technique for prism measurement in the six diagnostic, or cardinal, positions of gaze. This is accompanied by a simplified explanation of measurements and their significance. In the chapter on concomitant strabismus the treatment is directed toward correcting the cause and the pathological conditions established by the strabismus. Very little space is devoted to orthoptic training and it is gratifying to note that the author realizes that it is of limited value. The section on surgery gives specific procedures and exact techniques for operating upon the various muscles but the illustrations and the discussion on inferior oblique surgery seems inadequate.

The book is well written and it will be of value to ophthalmologists and all practitioners interested in strabismus.

IRVING FURTHBERGER

NETTLE ANATOMY. By Fred A. Mettler. A.M. M.D. Ph.D. 3rd ed. St. Louis: The C. V. Mosby Co. 942.  
STRABISMUS. CLINICAL HANDBOOK. By George J. Epstein, B.A. M.D. Philadelphia and Toronto: The Blakiston Co. 942.

IN her book *Breast Feeding*<sup>3</sup> the author has given many helpful suggestions and ideas gleaned from years of clinical study, avoiding as much as possible detailed technical data. Most of this material, however, is substantiated by scientific investigations.

Breast milk is not offered as the food of all infants. It is suggested that the mother's attitude and problems be thoroughly considered and investigated. The doctors who are willing to take the time and effort to discuss these factors with the mother and particularly the prospective mother will be in a better position to judge which women should nurse. Furthermore, such conferences give the physician an excellent opportunity to present the real reasons for nursing.

The properties of cow's milk and human milk are reviewed and the superior qualities of breast milk as an infant food are listed. It is stated that colostrum apparently does not have any specific value; therefore, the expression of this secretion daily for 3 months prior to the expected birth of the baby may be advisable. This procedure, learned from the experience of dalmatians, has reduced the incidence of mastitis and enhanced the early flow of milk.

Some different points on how to establish breast feeding in the first week of the infant's life are set forth along with sound reasons for the use of both breasts at each feeding. The stipulation to use only a spoon to give a complementary feeding will no doubt meet with some disapproval. The author's suggestion that large infrequent feedings in infancy will dilate the stomach and avoid anorexia in childhood, may also be questioned.

The technique for manual expression of breast milk is given in detail, offering many helpful suggestions about a lost art.

This small volume, devoted entirely to breast feeding, reviews and brings to focus a neglected phase of modern medicine.

L. M. ARTH HARTY

IN the seventh edition of *Recent Advances in Obstetrics and Gynecology*, Bourne and Williams do not presume to review all of the newest and most recent developments in obstetrics and gynecology. Rather as the senior author stated in the preface to the first edition, they attempt to present that new work which has been tested sufficiently to establish it as of real practical and prominent value and to record movements of thought and trends of opinion.

<sup>1</sup>HEALTH FARRER. By F. Charlotte Nash. London, New York, and Toronto: Geoffrey Cumberlege Oxford University Press, 942.

RECENT ADVANCES IN OBSTETRICS AND GYNECOLOGY. By Alice W. Bourne, M.A., M.B., B.Ch. (Camb.), F.R.C.S. (Eng.), F.R.C.O. and Leslie H. Williams, M.D., M.S. (Lond.), F.R.C.S. (Eng.), F.R.C.O.G. 7th ed. Philadelphia and Toronto: The Blakiston Co. 942.

The text is divided into sixteen chapters each of which is in essence a monograph on a particular subject. In that portion devoted to obstetrics the chapters on weight changes and water retention in pregnancy, lactation, erythroblastosis and radiology in obstetrics by E. Rohan Williams are particularly worthy of commendation. The discussion of lactation is an excellent summary of material not ordinarily available to the clinician.

Part II devoted to gynecology contains chapters on cancer of the cervix, stress incontinence, sympathectomy, penicillin in gynecology, radiological investigation and diagnosis in gynecology and x-ray therapy in gynecology. Many American readers will be surprised to find that the cytological diagnosis of genital cancer is not mentioned. The Aldridge modification of the Goebel-Stoeckel operation for urinary incontinence is shown in detail. The chapter on sympathectomy deals primarily with the value of sympathetic nerve block in femoral thrombophlebitis.

The text as a whole is an interesting commentary on a number of pertinent obstetrical and gynecological subjects.

JOHN HOFFMAN

THE name Devine is associated with the names of present-day leaders in the field of colonic and rectal surgery. The written word from such a source therefore is not to be taken lightly. It is no doubt a source of embarrassment to the publishers that the name is spelled Devine on the binding. As is stated in the preface, an attempt has been made to reflect the knowledge and wisdom that has been accumulated by the authors on the subject matter and the book accomplishes that purpose.

The book, *The Surgery of the Colon and Rectum*<sup>1</sup> is of convenient size, has good print and is well illustrated with diagrammatic drawings and photographs. In most instances the color illustrations seem to be superfluous and not essential. Color however usually has its advantages.

The subject matter deals with the usual and unusual benign and malignant lesions and has been arranged most carefully with a resultant ready reference book for the intern, resident or full fledged surgeon. The amount and variety of detail contained in the book are surprising and would presuppose dull reading but that is not the case. It is very easy reading and is without verbosity. Sentences are short, concise and to the point. Case reports are numerous and well selected to drive home specific lessons.

It would appear that the omission of figures and statistics has been deliberate since there are practically none in the 362 pages. It has been said that statistics can prove anything, sometimes even the truth. Despite the lack of statistics the book is of practical value. From it one will get the authors' reasoning and answers to many questions that one has or should have regarding the problems of colonic and rectal diseases.

THE SURGERY OF THE COLON AND RECTUM. By Sir Hugh Devine, M.D. and John Devine, M.D. Baltimore: The Williams and Wilkins Co. 1945.

All surgeons will not agree, although this reviewer does with the statement "The so-called aseptic anastomosis of the colon has not materially reduced the mortality rate." Neither is there unanimity of opinion regarding the advisability of side-to-side anastomosis, as compared with end-to-side or end-to-end anastomosis.

It is evident that the authors prefer multiple stage procedures in the majority of instances of resectable lesions of the right or left portions of the colon whereas the general trend in this country has been more and more toward one stage operations. The authors' preference is justified on the basis of their statement, "We feel that primary anastomosis of the distal colon, especially segmental resection of the rectosigmoid should be reserved for the highly or ganglionic clinic."

It is a bit disturbing to one whose training and experience have led him to avoid vaseline intraperitoneally to read of the free use of it on the exploring glove.

The experienced surgeon knows that there are many efficient surgical methods of arriving at the same objective. The purpose of the Devine book is not to cover the entire subject but to present the summation of their experience in the field it covers. The book is excellent from this viewpoint and is well worth becoming fingermarked from use by the student, medical or surgical, regardless of age.

CHARLES W. MAYO

WHEN Professor Minder went to lecture at Zurich at the end of 1944 the war prevented his return to Budapest so he utilized this involuntary vacation for a review of his knowledge in the remaining fields of medicine. He discovered that among the many good textbooks there were only a few which could serve as guides for the less experienced. He decided therefore to present urology by explaining first the most important urological problems and in the form of lectures in *Lehrbuch der Urologie*.<sup>2</sup> In this way he was enabled to describe in great detail topics of practical interest such as tuberculosis of the kidneys, disease of urinary calculi and hypertrophy of the prostate and to discuss problems which apparently lie outside the field of urology but which are important from the viewpoint both of the practitioner and specialist.

Simple methods of examinations and the use of special urological instruments cannot be taught without practical demonstrations. A detailed description of them is of little advantage for the general practitioner. Whatever the author has found as essential in this regard (such as introduction of catheters, the practice of massage of the prostate, or the essentials of lithotripsy, etc.) has been explained by diagrams.

The author did not have his library or clinical resources and very little of the comprehensive statistical data of the urological clinic in Budapest and the urological surgical department of the city of

LEHRBUCH DER UROLOGIE. By Prof. Dr. Med. J. Minder. Bern: Hans Huber, 1946.



Budapest with him in Zurich, so the greatest part of the lectures had to be composed without notes or the utilization of previous publications. He apologizes for omitting the names of authors which had escaped his memory and for not giving references to articles published on the subjects he has written about. All of his conceptions are based on his personal experience gained in large urological departments over a period of 25 years.

The lectures are 25 in number covering 317 pages with 35 diagrams, about 43 pictures of pyelograms, and 90 photographs mostly of specimens. The first lecture is a chronological history of the development of a modern urological clinic—Guyon's clinic for diseases of the urinary tract. The invention of the cystoscope by Nitze in 1888, the development of the urethral catheter and the retrograde pyelogram, better method of sterilizing instruments, improved anesthesia, and the development of kidney function tests all contributed to the reduction of the mortality rates of prostatectomy from 30 or 35 per cent to from 3 to 8 per cent and of nephrectomy from 15 to 25 per cent to from 2 to 4 per cent.

The problem of prostatectomy—suprapubic versus perineal—urinary antiseptics, the development of intravenous pyelography, the resectoscope and transurethral prostatic resection and finally chemotherapy, hormone therapy and penicillin therapy are discussed in the first part of the book.

The remaining 24 lectures cover the problems of urological symptoms: renal function and renal diagnosis from the urological standpoint; renal tumors and nephropathies; Tuberculosis of the kidney; ureter, bladder, and genitalia are well covered. The only important therapeutic measure not included is the use of streptomycin.

The lectures on urinary calculi are excellent. Those on diseases and pathological conditions of the bladder are well written as are the lectures on prostatic hypertrophy. The author discusses the theories of hypertrophy, the methods of removal of the gland, treatment of complications, and he includes mention of hormonal therapy.

Infections of the bladder, prostatic seminal vesicles and epididymis of gonorrheal and nongonorrheal origin and the modern therapy of each are well discussed.

Less important or rare diseases have only been touched upon in a brief appendix. These include epispadias, hypospadias, eunuchism, prostatic abscess, orchitis, epididymitis acute or chronic, varicocele and urethral strictures.

The alphabetical index is well and effectively arranged.

KNOWLTON E. BARKER.

GRAY'S *Anatomy of the Human Body*<sup>4</sup> now in its 40th year of publication, has recently (July 1948) been published in its 25th American edition. While fundamental changes have been made in

the plan of this justly famous book, a few changes in text, figures, and editorial policy are noted which may or may not meet with the approval of all anatomists.

The most significant change noted relates to editorial policy. The editorial board of seven professional anatomists has been discontinued in favor of one man editorship. It is not likely that this change in editorial policy will be of immediate importance since the encyclopedic anatomies of this type are changed but little from one edition to the next. In the long run, however, a doubt may be entertained as to one man's competency in the several branches of anatomy to maintain all sections of such a comprehensive work in a state of up-to-date and authoritative revision.

Other changes noted pertain to text, figures, and table of contents.

Only the text of the section on muscles and fascias shows evidence of extensive revision. Muscles are treated individually in regard to action and nerve supply. This is not new but is a reversion to the arrangement followed in most of the standard texts a few editions back. This straightforward treatment of muscle action is much to be preferred over the descriptions by groups as in the 24th edition of Gray and recent editions of other standard texts. Medical students have no difficulty in grasping the concept of synergistic and antagonistic action of muscles, but they do find it unnecessarily time consuming to dig out individual muscle action from the group descriptions in the previous edition and in other texts. The concept of group action is not sacrificed, but is considered appropriately following the study of individual muscle actions. A tedious section on the mechanics of muscle action has been omitted.

Descriptions of regional fascial layers have been amplified and improved. This is an important addition which might well have been carried further.

The table of contents has been condensed from 8 to 4 pages, a great improvement from the standpoint of convenience and utility.

No change is made in the old half functional and half anatomical classification of joints. This reviewer favors the classification of the three major types on a morphological basis: fibrous, cartilage and synovial. This classification puts the emphasis on development and structure, where it logically belongs.

A slight concession to practical anatomy is noted in a reference to J. F. Huber's system of bronchopulmonary segments. The section on surface and topographical anatomy impresses the writer as a completely useless appendage. It is too sketchy to be of practical use and a great deal of its material is taken from other sections of the book. What little new material there is in this section might well be incorporated in other appropriate sections of the book.

The illustrations in the 25th edition are brighter and a few new ones have been introduced, but there

A TORY OF THE HOW POOR By Henry Gray F.R.S.  
4th ed. Edited by Charles Mayo Goss, M.D. Philadelphia  
Lippincott 1948.

is still a serious lack of cross sections and other types of sectional figures.

One concept of anatomy exemplified in early editions was that of its usefulness to surgery. Brief comments on regional surgical applications are interspersed throughout the original text. All such practical references have been extended from recent American editions as a threat to the purity of the science. Many teachers of the basic medical sciences appear to entertain a great fear of contamination by any reference to useful application. Gray was apparently in agreement with the reviewer in his belief that scientific method and thought must be carried through to the so called clinical years and into practice if the highest possible standards of medical education and medical practice are to be achieved. Investigations begun for a practical purpose may lead to profound philosophical deductions, and the reverse may also be true.

The fact that Gray's *Anatomy* has enjoyed great prestige for almost a century without significant change in plan or arrangement of subject matter is a great tribute to the author who incidentally was only thirty-one when the first edition was published. It is no tribute, however, to modern generations of anatomists that no modern text has appeared to compete with Gray or the other bulky texts. In Gray's time the term anatomy covered the field. Now medical students are required to supply themselves with texts of histology, embryology, neuroanatomy and gross anatomy. Yet the great and bulky old anatomies retain sections on these subdivisions which are now inadequate to meet the needs of medical students, teachers or physicians. Students pay for material they do not use and get an unwieldy book which, in modern regional dissection and study of gross anatomy, is extremely inconvenient and wasteful of the student's time.

What medical students need is a textbook of gross anatomy designed to meet present day teaching methods mostly regional in arrangement with more functional implications, better illustrations and a more straightforward, readable text.

SYDNEY EVANS JOHNSON

SINCE 1915 when *Treatment by Manipulation in General and Consulting Practice*<sup>1</sup> first appeared it has remained a classic in the field of manipulative surgery. The fifth edition contains much new material with numerous illustrations which enhance its value.

The author's approach to the subject is well balanced and refreshing. There is no attempt made to set forth manipulation as a panacea for all joint disease. Advantages, disadvantages, indications and contraindications are clearly described and details pertaining to each joint are discussed. The conditions which may be benefited by manipulative treatment are confined to four main groups: articular

or periarticular adhesions, subluxations and dislocations of joints, tendons or intra-articular discs, adhesions in connection with muscles, tendons or fascia, and certain functional or hysterical conditions of joints and of the spine.

The first five chapters deal with the historical background, the pathology, the prevention and diagnosis of adhesions, and the general principles of manipulative treatment. The remainder of the book is devoted to a detailed discussion of the joints of the upper and lower extremities, the spine, and the sacroiliac joints. This discussion includes a description of the anatomy, prevention of deformity in dislocations for manipulation and technique. Case histories illustrating the use of manipulative surgery in each joint discussed are included. The concluding chapters are rather sketchy but endeavor to point out the possible dangers of manipulation and the need for adequate after care.

The book is the result of many years of experience and mature evaluation by the author in the field of manipulative surgery. It is a work that should be in the library of all who are concerned with joint diseases.

WILLIAM A. LARSON

THE comprehensive and inclusive report, *Nursing for the Future*<sup>2</sup> prepared by Dr. Brown is both a challenge and a constructive awakening to the nursing profession as well as allied professions. Science in all of its many phases, industry, economics, business and sociology have kept pace with one another in rapid advancement in order to remain an integral part of modern civilization.

It is the responsibility of the nursing profession to attain and maintain standards of nursing which are comparable and on a level with the educational trends of today. This endeavor cannot be accomplished without co-operation from other professional forces involved nor can it be accomplished through traditional standards and reminiscences. It must be a direct straightforward move with discretionary disregard for time worn measures and custom.

We must maintain adequate nursing care which is both quantitatively sufficient and qualitatively efficient. With this point in mind it becomes necessary to consider nursing from a comprehensive point of view. There must be no differentiation in our basic attitude which will divide professional graduate nurses from licensed practical nurses. Nursing functions must be considered in a like manner.

The role of the graduate registered nurse today and in the future is one of supreme importance and responsibility. It is a task which in order to be successfully accomplished requires the aid of co-operative assistants including practical nurses, attendants and other subsidiary workers. Therefore personal and personnel relationships within all fields of nursing must be in complete rapport in order to allow for co-operative and efficient functioning.

<sup>1</sup>TREATMENT BY MANIPULATION IN GENERAL AND CONSULTING PRACTICE. By A. G. Timbrell Fisher. 5th ed. New York and London: Paul B. Hoeber Inc., 1948.

<sup>2</sup>NURSING FOR THE FUTURE. A Report Prepared for the National Nursing Council. By Esther Lucile Brown, Ph.D. New York: Russell Sage Foundation, 1948.

The burden of this increased responsibility is accordingly greater for the registered professional nurse and she must be theoretically and practically trained to execute her role. She must be trained and educated to the extent that she will possess the knowledge and ability to supervise constructively and instruct other nurses and subsidiary workers to formulate and develop new techniques in nursing care, and contribute to world wide health movements on an equal plane with allied professions.

Professional nursing education today is on a university level, therefore nursing services to maintain progress must be reorganized. The conditions found in many schools of nursing today are incredible. They are not schools in any sense but rather means for student exploitation partially disguised by the organization of the hospitals concerned.

Dr. Brown's report was published under the auspices of the Russell Sage Foundation. The National Nursing Council promoted this study concerned with the reorientation of nursing education.

Concise and precisely this report contains the following recommendations for nursing education at the present time and in the future that

1. The profession take steps to study thoroughly and examine every school of nursing and publish and circulate freely a list of accredited schools of nursing.

2. The necessity for increasing salaries and prestige be thoroughly considered and results expedited.

3. Nonprofessional nurse programs of training be established and maintained on a national basis with definite prerequisites for licensure.

4. The nursing profession establish and maintain definite levels of professional achievement in order that promotions and advancement will be governed by preparation, experience and achievement.

5. The nursing profession allow for education of the public to the problem at hand and thereby obtain co-operation, support and participation.

The health and hygiene needs of society today prompted this study and Dr. Brown has extensively and intensively presented these needs as well as recommendations for meeting them in a modern progressive manner. These recommendations are only the beginning for the reorientation of the profession and it is the responsibility of each and every member of nursing to participate whole heartedly in this great movement.

KATHERINE E. BALST.

## BOOKS RECEIVED

Books received are acknowledged in this department, and such acknowledgment must be regarded as a sufficient return for the courtesy of the sender. Selections will be made for review in the interests of our readers and as space permits.

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March, 1949

# SURGERY GYNECOLOGY AND OBSTETRICS

*Supplement*

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## COLLECTIVE REVIEW

### SEPARATION OF THE CAPITAL FEMORAL EPIPHYSIS IN THE ADOLESCENT

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**S**EPARATION or slipping of the capital femoral epiphysis in the adolescent is one of the most controversial subjects in the orthopedic literature. Although the term "slipped epiphysis" is a misnomer it has enjoyed common usage and will be employed in this paper despite the fact that various names such as epiphyseolysis, sliding of the femoral epiphysis, adolescent coxa vara, osteochondritis of the neck of the femur, epiphyseal fracture of the hip joint, epiphyseal coxa vara, and epiphyseal coxa anteverta have, at various times, been introduced.

This condition consists of a separation of the head and neck of the femur occurring at the metaphyseal side of the capital femoral epiphysis, with a subsequent gradual or sudden change in the relation of the head to the neck. The head, contrary to its title does not slip but remains in approximately its normal position in the acetabulum, while the neck rides upward and forward, resulting in external rotation and slight shortening of the extremity.

Slipping of the femoral epiphysis at its proximal end was first recognized by Brousseau in 1867. Not until 1888 however was the condition described by Muller. Subsequently numerous articles have appeared in the literature devoted to the various phases of etiology and treatment. Key, and Noble and Hauser in 1926 in extensive reviews of the literature, did much to stimulate interest in this condition, and since that time extensive study has been carried out.

The purpose of this paper is to review the extensive amount of work which has been done on this subject so that a clearer understanding of the problem at hand may be gained.

#### INCIDENCE

Slipped epiphysis in the adolescent is the most common cause of disability involving the hip. Scott placed it fourth as the cause of all disabilities involving the hip including tuberculosis. Waldenstrom, reporting from Sweden, found that of 16 000 patients seen in the Orthopedic Hospital over a 5 year period 111 or 1.70 per cent, had slipped epiphyses as compared to 1.84 per cent with Legg Perthes disease. Sullivan stated that at the Boston City Hospital Clinic an average number of 12 patients a year was seen. Key described slipped epiphysis as the most common cause of hip disability in the adolescent, pointing out that less than 10 per cent of the cases of tuberculosis of the hip begun at this time. Legg Perthes disease is well recognized as occurring in a younger age group. Wilson (54) in reviewing the fractures of the neck of the femur in children seen at the Los Angeles General Hospital, reported that within a period of 10 years only 10 fractures of the femoral neck were seen.

This condition then is characteristically one of adolescence. This is even reflected in the different ages of onset in the two sexes, the earlier onset in females corresponding to an earlier peak of adolescence. Males are more commonly affected than females. Although MacAusland reported an incidence of 80 per cent males, and Ferguson and

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4. Circulatory changes in the femoral head. Contrary to the popular belief that the nourishment of the femoral head in infants and children is due to a patent artery in the ligamentum teres which penetrates the head, Wolcott in studying the femoral head found that in infants and children the artery of the ligamentum teres does not penetrate the femoral head or contribute to its nourishment until about the twelfth or fourteenth year of life, and in 20 per cent of the cases never penetrates the head. He pointed out that this fact may have some bearing on the etiology and Carrell and Carrell attributed the large percentage of aseptic necrosis of the femoral head in fractures of the neck in children to this fact.

5. Psychologic changes. This period often engenders a much greater desire to excel in sports and other physical activities and a growing resistance to restraints imposing normal rest.

*Theories of etiology* Three principal theories have arisen to explain the occurrence of the lesion drawn from the above collection of facts and from observation of patients clinically and pathologically. It is probable that more than one theory may be active in any given case with various factors interacting to produce the lesion.

1. Traumatic theory. Trauma apparently plays a very definite part in the production of slipped epiphysis, and many authorities adhere to this as being the sole cause of the condition. Most authors agreed that trauma of either slight or great degree was the most common precipitating factor in the onset of symptoms, although there was disagreement as to whether trauma alone could displace a normal femoral epiphysis. Kleinberg and Buchman (28) Ghormley and Fairchild and others pointed to the physiological changes in the epiphysis which render it mechanically more susceptible to traumatic separation, pointing particularly to the more oblique position of the epiphysis, the widening of the epiphyseal plate and the change in the angle of the femoral neck. They felt that these factors in the presence of trauma were the principal predisposing factors in the development of the lesion. Key stressed the thinning of the periosteum, which in childhood is thick and strong. In adulthood after the bone becomes completely ossified the periosteum then becomes thin. Key felt that with this rapid thinning over a still cartilaginous union, sufficient weakening was produced in this link between the head and the neck to allow separation induced by even minor trauma. Wilson (55) also stated that the periosteum was the chief sustaining band between the epiphysis and the diaphysis, and quoted experiments carried out by Oliver and

Poland on cadavers in which this was demonstrated. Ghormley and Fairchild, on the other hand demonstrated a case of nearly complete separation of the epiphysis in which the periosteum was still intact and believed that the thinning was secondary to stretching rather than a primary contributing factor to the separation.

Badgley Sever, and Ghormley and Fairchild agreed with Walsley's theory that the mechanism of displacement is produced by an extension force applied to the head of the femur locked in the acetabulum. Walsley showed that at 15 degrees extension the head of the femur is locked securely in the acetabulum further extension being precluded by the iliofemoral or "Y" ligament of the femur. Hyperextension beyond this point, he believed would result in motion at the epiphyseal line.

Taylor believed that in the acute type with a single injury and sudden onset of symptoms, a fracture is sustained through the juxtaepiphyseal line with resultant loss of continuity. Sutra, and others, believed that the pathological findings are those of fracture through the epiphyseal line with subsequent attempts at healing. Brogren believed that trauma plays a very important part in the production of slipped epiphysis and suggested the term epiphyseal fracture for the acute traumatic type.

If trauma is accepted as the only cause of slipped epiphysis, even with the added factors of physiologically increased vulnerability of the epiphysis, it becomes difficult to explain the relative infrequency of this condition in adolescents who are repeatedly exposed to trauma of all degrees of severity. Likewise the fact of fairly frequent bilateral occurrence, the second hip often being affected while the first is under treatment, is hard to understand on the basis of trauma alone. Foley stated trauma can never displace the normal upper femoral epiphysis if it is severe enough it will fracture the neck, leaving the epiphysis undisturbed. He quoted the experiments carried out by Allernshaw and Wood Jones to demonstrate this. Howorth in 1941 considered trauma only an incidental cause of slipping.

It appears that there must be in these adolescent girls and boys some additional factor which makes them more susceptible to the usual trauma than the majority who do not develop slipped epiphysis. If a softening or loosening of the epiphysis occurs, it is easier to understand how even minor trauma, such as the static effect of overweight, muscle pull, and slight injuries can produce displacement. Many authors have proposed an endocrine background for such changes

Howorth an incidence of 56 per cent males, the average ratio in all of the reported cases was approximately 2 to 1 in favor of the males. All authors agreed that the lesion appeared somewhat later in males than in females. The mean age of onset in the girl was at 12 years, and in the boy at 14 to 15 years. Ferguson and Howorth, in a series of 70 cases, reported also a seasonal variation corresponding to periods of greater activity thereby adding one month to the summer for the boys, to include the football season.

Although there was considerable variation in the reports of different series, in the ratio of involvement of the left to the right hip, the average ratio for the reported cases was approximately 5 to 4.

There was even greater variation in the reports on the number of cases with bilateral involvement, possibly related to interest and study of both hips in patients with apparently unilateral involvement. The average incidence reported was the same as in those cases reported by Key before 1926 or approximately 15 per cent.

#### ETIOLOGY

In considering the etiology of this disease, the outstanding fact noted was that almost without exception the onset occurred during adolescence. Likewise, in the individual child, it was reported by several authors, the parents described the onset as following a period of "growing like a weed" although there had been no actual measurements, periodically of the height of these children preceding the onset.

It is of interest to review some of the changes occurring in the body during the adolescent period with a view toward their possible bearing upon this condition.

*Local changes at the capital femoral epiphysis.* Key, Badgley, Kleinberg and Buchman (38) and others have pointed out a number of changes which normally occur at this epiphysis and the surrounding area during this period.

1. The epiphyseal plate which normally occupies a horizontal position during childhood, assumes a more oblique relationship during adolescence.

2. There is a spurt of increased growth at the epiphysis with some physiological widening of the epiphyseal plate.

3. Thinning of the periosteum and the retinacula of Weitbrecht connecting the head to the neck occur.

4. The neck of the femur lengthens and increases in density, lessening its angle of junction with the shaft.

#### *General changes in the body*

1. Changes in height weight relationship. Noble and Hauser have shown that the weight curve reaches its greatest relative peak during this period. Also at this time the so-called Froehlich's syndrome is likely to develop. This condition has recently been termed by Warkany as benign adiposogenital dystrophy of adolescence, and is only slightly less common in girls than in boys. As slipped epiphysis is common in this group it may be described more fully. These children show not only adiposity particularly in the mammary and abdominal regions and in the upper arms and thighs, but also exhibit increased skeletal and muscular development, and are often described as "overgrown." Relatively small and sometimes proportionately "underdeveloped" genitalia are often present in the males. Corrected basal metabolic rates in these children are normal or elevated and the obesity usually subsides after maturity is reached. The genitalia then appear normal. Warkany, Newburgh, Bruch (9, 10) and others have emphasized the absence of hypothyroidism in these children, and believed that the condition might be due to transient changes in the endocrine balance with possible hyperfunction of the thyroid or anterior pituitary.

Other children at adolescence show a sudden, rapid increase in height, becoming much taller within a short period of time.

2. Chemical balance. Johnston (25, 26) has shown that the adolescent child exhibits a marked tendency toward the development of negative nitrogen and calcium balances. This is particularly true in the "overgrown" child described above. He studied 3 patients with slipped epiphysis, all of whom were found to have negative, or very low calcium balances, but which could be corrected or improved by the administration of vitamin D. He recommended prophylactic administration of calcium with vitamin D in the preadolescent period. Ghormley and Fairchild reported blood chemistry studies on 4 patients in whom the calcium was normal or high. Very few reports were made on blood chemistries in these patients although it was agreed that neither chemically nor pathologically was there found evidence of rachitic changes.

3. Endocrine changes. The exact nature of the endocrine changes of adolescence has not been worked out. It has been shown by Johnston (25, 26) that hyperthyroidism in children reaches its peak at this period, often subsiding as maturity is reached. Even more often hypothyroidism is present in a mild degree, evidenced not by obesity but by delayed growth and development, fatigue and inattention.

tendency to pannus formation. The synovial fluid was often increased in amount, and frequently softening of the epiphyseal line could be felt with an instrument. Microscopic examination reveals edema and hypervascularity of the synovia with a collection of round cells about the small blood vessels. Cultures were persistently negative attributed to technical difficulties or to failure to obtain the culture early enough. He concluded that the primary condition was a synovitis of the hip during a period of rapid growth and that this lesion caused circulatory changes in the epiphyseal disc resulting in decalcification and softening. Foley confirmed the findings of Howorth, but brought up the question of whether the synovitis is a result of or a cause of the slipping. Balensweig also a believer in an infectious etiology believed that there is a metastatic infection in this condition as well as in Legg Perthes disease and osteoarthritis similar to that in hematogenous osteomyelitis, with localization here in the juxtaepiphyseal region. He preferred to call this osteochondritis of the hip and believed that in the first decade of life one may have Legg Perthes disease in the second decade slipped epiphysis, and in the third decade osteoarthritis. Capener reported 2 cases of acute infection with fever at onset, in which intra-articular hemorrhage was later thought to be responsible for the slight temperature elevation, but when first seen infectious metaphysitis was considered.

The opponents of this theory pointed out consistent failure to obtain positive cultures, the general well-being of the patients, absence of fever or other systemic manifestations and normal sedimentation rates.

#### MECHANICS OF SLIPPED EPIPHYSIS

In order to understand slipping of the epiphysis, it is necessary to review the anatomy and mechanics of the normal hip joint (22-34). This is a typical ball and socket joint, the head of the femur fitting closely into the acetabulum for an area extending over nearly half a sphere. At the margin the bony cup is still more closely embraced by the glenoid labrum so that the head is held in place by that ligament even when the fibers of the capsule have been divided. The capsule, which completely invests the head and a large part of the neck is strengthened anteriorly by the iliofemoral ligament which curves around the anterior surface of the neck of the femur and the joint, and prevents extension of the lower extremity beyond a straight line with the body. Blood supply reaches the head via vessels running along the neck in reflected portions of the

capsule. The major blood supply arises from the medial circumflex artery and lies within the posterolateral quadrant of the visceral capsule.

This joint can move around three axes: a transverse axis around which extension and flexion occur, a vertical axis for medial and lateral rotation, and a dorsoventral axis for adduction and abduction. The three axes intersect in the center of the head of the femur. The transverse axis lies somewhat anterior to the center of gravity of the body and in the erect position, there is a tendency for the pelvis to rotate backward being checked normally by the tension of the iliofemoral or "Y" ligament. The vertical or mechanical axis falls medial to the shaft of the femur as the shaft inclines downward and medially. The dorsoventral axis passes between the margins of the acetabulum and through the center of the femoral head.

The relation of the neck to the shaft is also important in motion at this joint. If it turned directly medially from the shaft, motion at the joint would be angular, and marked change in relation to the articular surfaces of the head and acetabulum would result, for example, in transit from flexion to extension. Actually the neck turns obliquely upward to an approximate angle of 120 degrees, and also has normally about 12 degrees of anteversion so that motion at the joint is always rotatory and gliding as well as angular and therefore the articular surfaces always remain in close contact.

The direction of thrust of normal body weight when the body is in the erect position is downward backward and outward. The head of the femur is set like a cap on the upper convex end of the neck with the epiphysis looking obliquely upward and medially. When separation occurs it always is on the diaphyseal side of the epiphysis.

Assume an individual standing erect. He is an overweight adolescent boy who has developed a change in his epiphysis which renders it softer and more fragile than normal. As he stands, with the pressure of his weight pushing downward and backward on the head the head is supported posteriorly by the acetabular margin and locked securely in place anteriorly by the iliofemoral ligament, which blocks any further forward progress of the head. The force is transmitted therefore, through the epiphysis to the neck. The attachment of the epiphysis posteriorly and inferiorly is supported by a projecting lip or buttress of bone and by the periosteum which is thicker and stronger here than elsewhere. Anteriorly however the periosteum is the only connecting support and is rather thin. Consequently as Milch has emphasized the cartilage of the epiphyseal



**Endocrine theory** There are a number of factors which support the theory that unusual softening of the epiphysis leading to separation may have an endocrine basis. First is the fact that the slipping always occurs at the peak of rapid growth at a time when profound changes are occurring in the body under the control of incompletely understood endocrine influences. Ferguson and Howorth, in a report of 70 cases, stated that in the few cases which occurred before the actual spurt of adolescence other factors such as overweight and trauma were unusually prominent.

The fact that the lesion is often bilateral also leads one to suspect that a similar change is occurring simultaneously in both epiphyses.

There is some suggestion of increased familial incidence, although there are few detailed reports concerning this point. Scott reported one case in which the father also had a coxa vara, and Compere reported the case of a family in which two brothers and a sister were affected with slipped epiphysis as they approached adolescence. The fact that has been repeatedly noted by many authors was that the lesion is very often associated with a particular type of body build primarily the so-called Froehlich type individual and secondly the very tall thin person. The exact nature of endocrine disturbances in these individuals has not been determined. Yet, it has been well shown that particularly in the obese children, there is a much higher familial incidence of obesity and also of diabetes mellitus than in the normal population.

Noble and Hauser stressed the importance of endocrine factors. MacAusland reported 42 per cent of 45 patients to be obese or with other unspecified endocrine disturbance. Forrester Brown reported the finding of such changes in 86 per cent of 11 cases. Brogden, in 65 per cent of 57 cases, Badgley in 5 per cent of 27 cases. Ghormley and Fairchild, in 26 per cent of 55 cases and Pomeranz and Sloane (40) in 40 per cent of 101 cases. Scott stated that "Endochondral ossification is largely dependent upon function of the sex glands and the hypophysis, for many cases point to disordered function of these glands," but gave no evidence of their disordered function. Ghormley and Fairchild stressed the fact that 61 per cent of their 55 patients showed normal or only slightly excess weight. They did not state whether measurement of weight was judged in relation to height, which in overgrown children is often also above the average.

Wilson (57) also brought out the fact that even when slipping occurs on one side early in adoles-

cence and is quite severe, the final shortening as compared to the other side is usually relatively slight. He believed that in these cases early closure occurs on the involved side as well as on the uninvolved side indicating a metabolic disturbance.

The fact that these lesions may occur gradually with absolutely no history of trauma greater than the normal trauma of weight-bearing and muscle pull across the joint also suggests that there must be abnormal softening or loosening before slipping can occur.

As to the actual mechanism in which ossification is disturbed, little is known. Benjamin and Miller found that children suffering from thyroid deficiency encounter a disturbance of ossification involving the proximal femoral epiphysis. In cretins the normal epiphyseal plate is replaced by a disc type zone of solidly calcified cartilage in apposition to a transverse layer of bone. This type of union is incapable of resisting normal stress and is often displaced. Waldenström believed that there is a disturbance of ossification at the junction of the epiphyseal cartilage with the metaphysis during puberty. Because of this, the disturbed cells do not hold firmly enough to resist the pressure exerted when weight is borne so that a displacement occurs in the zone of ossification. He stated that the cause of this disturbance is obscure but there may be sufficient endocrine change to effect this appearance without external manifestation. Bernstein and Arens corroborated this theory and felt that slipped epiphysis is analogous to vertebral epiphysitis and Osgood Schlatter's disease. Snodgrass reported the case of a 13 year old colored boy with slipping of the epiphysis and Osgood Schlatter's disease of concurrent onset.

**Infectious theory** The support of the infectious theory is rather weak and has few adherents. Ferguson and Howorth, in 1931 stated that they believed that "weakening at the epiphyseal disc is due to vascular stasis about it secondary to sclerotic changes in the soft tissues about the femoral neck. The most probable cause of the sclerotic changes in the soft tissues is a previous, or occasionally concurrent, infection a subacute arthritis, or rarely infection of the neck. Seventy-five per cent of the patients in their series of 70 cases showed mild infections in other parts of the body. Howorth later studied 17 hips in the pre-slipping stage and 23 hips in the slipping stage, and reported that early the capsule of the hip was edematous and thickened the periosteum of the neck and synovial membrane were almost always thick, red, softened, and vascular with a

The line of demarcation between bone and cartilage is fairly well preserved, the columnar arrangement of the cartilage persisting although it is somewhat irregular and the number of cells is reduced. The resting cartilage appears fairly normal but there are scattered splits and in some areas, fibrous tissue apparently filling similar splits in an effort at repair. Some of these areas of fibrous tissue are undergoing ossification. The osteoid tissue at the junction with the metaphysis is irregularly disposed as is the newly formed lamellar bone. As the disease progresses the same changes become much more marked until, in advanced stages, the normal characteristics of the cartilage-bone contact zone are completely lost. At that time enchondral ossification has been completely replaced by irregular fibrous bone formation. Areas of degeneration, hemorrhage, and necrosis appear. The authors described the picture as one of a completely chaotic arrangement of normally functioning cells interspersed here and there with areas of necrosis and areas of hyper-vascularity.

#### ROENTGENOGRAPHIC FINDINGS

The roentgenological appearance of the lesion may be predicted from the previous discussion of pathology.

*Early or preslipping stage.* Here there is seen only widening and possibly slight irregularity of the epiphyseal line with a little later slight rarefaction of the adjacent bone of the metaphysis. Careful comparison should be made to the opposite hip and a lateral roentgenogram of the suspected hip should always be made because often an anteroposterior view is confusing and may not reveal the true extent of the pathology.

*Slipping stage.* Mayer and Pomeranz (39) reported that the earliest roentgen evidence of slipping of the epiphysis was the disappearance of the slight hump or hump on the upper margin of the head and neck junction, and conversely the appearance of a slight prominence of the lower margin. Milch stated that very early by lateral stereoscopic views a slight slipping in the anteroposterior plane could be demonstrated before any upward displacement occurred. He pointed to the subcapital shadow which as he demonstrated experimentally in monkeys by loosening their epiphyses and taking roentgenographs of the femurs (in different positions) with known amounts of artificial slipping is actually the anteverted proximal end of the neck seen first in profile and then end on. The diminution in width of the epiphysis as seen in an anteroposterior view after slipping has occurred is due to the backward rotation of the

epiphysis, the posterior and inferior margin of which is often visualized as a dim shadow through the shadow of the neck. Milch, Wilson (57), Kleinberg and Buchman (28) and others have pointed out that the roentgenographic appearance may vary with changes in position of the extremity and may lead to false belief that reduction of a separation has been obtained when the film is made with the leg in internal rotation due to superimposition of the shadows of the epiphysis and the anteverted end of the neck.

In traumatic separation of the epiphysis the line may appear hazy because of the presence of hemorrhage.

*Late changes.* The neck appears shortened and greatly thickened and the outline of the head is very irregular and flattened and often irregularities due to arthritic changes appear.

#### CLINICAL MANIFESTATIONS

Key gave a classic description of the clinical manifestations and little can be or has been added to this.

The onset of symptoms in this condition may be gradual and insidious or may appear very suddenly or there may be a sudden exacerbation of previously mild symptoms, occasioned by sudden acute slipping.

The first symptom is often mild pain in the hip or more commonly on the medial side of the knee. A slight limp may appear intermittently gradually becoming persistent. The patient may notice unusual fatigue on walking or standing. The pain at first is completely relieved by rest, later becoming more persistent. There may be no history of trauma, or if there is it is often found that mild symptoms have been present for some time preceding it. Such patients infrequently consult a physician until symptoms have been present for several weeks or even months, simply considering them as growing pains. Careful examination at this point will usually disclose slight limitation of internal rotation the patient tending to hold the leg in slight external rotation and possibly some limitation of abduction. At this early period there may be no other signs than those mentioned and these are elicited only by very careful comparison with the opposite hip. Widening of the epiphysis is shown in the roentgenogram with no or slight separation of the epiphysis. Diagnosis made at this time offers the best opportunity for successful treatment therefore it is important to stress the fact that any limp in an adolescent, particularly of the body types most commonly affected, should be carefully investigated without delay. Once this process has begun

plate begins to appear wider anteriorly and superiorly narrowing slightly posteriorly as the neck of the femur assumes a gradually increasing degree of anteversion. Milch felt that, in addition as the leg is put into eversion during activity, the head follows it as it rotates until the ligamentum teres becomes taut. As the head can no longer follow if the epiphysis is softer than normal, an acute slipping in the anteroposterior plane occurs at this point, the neck assuming a more anteverted position than the head therefore rolling out into external rotation. It is only after the neck becomes so anteverted as to be no longer supported by the epiphysis that it begins to slip upward. At this early stage, before upward slipping occurs, X-ray studies disclose the characteristic early widening of the epiphysis. Milch stated that this is only apparent and is actually due to the shadow of the anteverted proximal end of the neck. Kleinberg and Buchman (28) in surgical observation of early cases, have observed the characteristic wedge-shaped deformity of the epiphyseal plate and noted that union with the head and neck still seemed quite firm. Probably both observations are correct as anteversion and slipping occur gradually with concomitant repair process, so that the epiphysis actually does become widened anteriorly and superiorly at the point of greatest strain.

As the process progresses, the neck becomes more anteverted and the shearing force of body weight plus muscle pull, particularly in hyperextension, or with sudden external rotation force, causes the neck to gradually slip upward and forward on the head with a consequent rise in position of the greater trochanter and loosening of the iliofemoral ligament, allowing for further external rotation and limitation of abduction by approximation of the trochanter to the side of the pelvis. External rotation is maintained by the external rotators, which are stronger than the internal rotators, and by the altered action of the iliopectaeus, which tends to rotate the distal fragment outward when there is separation of the head and neck. As the neck gradually rises, the head may rotate into a position of flexion while the femur if the head is in its normal position has a position of hyperextension. The posteroinferior border of the neck in extension may sink into the cancellous part of the head so that the head overlaps the lower and inferior aspect of the neck and produces apparent shortening of the lower margin. On the other hand, the protruding end of the neck superiorly gives the appearance of lengthening and may become rounded off to articulate with the acetabulum. As the metaphysis first rises

above the epiphysis, the overlying cartilage becomes thin and bluish, the periosteum is markedly stretched and may become torn and fracture may occur at the anterosuperior margin of the junction of the epiphysis and metaphysis through the epiphyseal line. Inferiorly the periosteum is rarely disrupted but is torn up from the lower surface of the neck. If rotation of the head occurs, it may be twisted so that its fibers run obliquely upward toward the epiphysis.

All of these changes may occur suddenly in the presence of appropriate trauma, and the epiphysis may suddenly be completely separated from the shaft.

#### PATHOLOGY

The gross appearance of hip joints involved in this process is easy to understand in view of the above facts. Early there has occurred slight anteversion of the femoral neck, as compared with the normal, opposite side, with a wedging of the epiphyseal plate with its base anteriorly and superiorly. The articular cartilage appears normal, and there is no bone atrophy. The lower margin of the neck is normal in length while the upper margin may be slightly longer due to widening of the epiphyseal plate. In early slipping the cartilage superiorly is thinned along with the periosteum, and bluish, as the cancellous bone ablates through. There begins to be a little lengthening of the upper margin. Cartilage of the lower margin appears normal and may begin to overlap the lower posterior margin of the neck so that this appears shortened. Late in the disease the crescent shaped head with its epiphysis, may have been far overtaken by the upper and anterior surfaces of the end of the metaphysis which have been covered with fibrous tissue and smoothed off to form part of the articulation with the acetabulum which has become egg-shaped to fit. The lower part of the head completely overlaps the lower inferior part of the neck, and fuses with it. The bone of this part of the neck is markedly thickened to withstand the extra strain imposed upon it in the inefficient joint.

The microscopic pathology has not been studied adequately in the very early cases due to the fact that specimens were difficult to obtain at this period. Howarth's studies of 40 hips at a fairly early stage in the process have been mentioned. He attributed the findings to infection. Sutra examined specimens removed at operation and reported "no evidence of rickets, osteomalacia or specific osteitis fibrosa." Kleinberg and Buchman (28) in a study of epiphyses removed early at operation, gave a good description of early changes.

vitamin or mineral imbalances, and other measures directed toward improvement of general health are of value in speeding ossification of the epiphysis.

Because further slipping has frequently been noted to occur while the patient was under conservative treatment (16 55), and in an attempt to accelerate healing, various surgical procedures have been devised.

Jahss (24) attempted to obtain a premature fusion of the epiphyseal line by hammering of the greater trochanter with a Cotton mallet while there was still fairly good position. Others drilled through the epiphyseal plate from the upper surface of the neck, hoping to obtain better vascularization and earlier fusion. Ferguson and Howorth drilled and added silver bone grafts or bone pegs through the holes in an attempt at immobilization of the epiphyseal plate. Wilson (57) inserted a Smith Petersen nail through the trochanter and neck into the head in an effort at fixation to prevent further slipping. He reported 14 cases in which the Smith Petersen nail was used with excellent results in 10 cases, after a 4 to 34 month follow up period. Compere advocated the use of threaded wires instead of the Smith Petersen nail to secure fixation. Kleinberg and Buchman (28) completely removed the epiphyseal plate.

*Stage of gradual slipping.* At this point slipping has advanced more than three-eighths of an inch, but there is still union between the head and neck, as the epiphysis is only partially displaced and there is usually a variable amount of callus formation between the lower margin of the neck and the overlying lower margin of the displaced head, further strengthening the attachment maintained by concomitant fibrous and bony repair in the weakened epiphyseal junction.

Great discussion has arisen as to the necessity or advisability of accurate replacement of the epiphysis. It was generally believed that if not corrected, arthritis is prone to occur as a late sequel. However a high incidence of similar complications has been reported in patients treated by manipulation, and, especially by open reductions. Moore felt that any treatment further endangering blood supply to the epiphysis encourages development of changes in the overlying articular cartilage. Ferguson and Howorth stated that average function is less with greater displacement, but this is partly accounted for by greater traumatism in treating them.

Apparently much of the deformity and limitation of function at this stage is due to muscle spasm, as it has long been known that rest alone

will result in improvement of function. Ferguson and Howorth, and Wilson (57) have treated patients with mild displacement conservatively with good results. The only large series reported was that of Moore, who treated mild to moderate displacement by immobilization in casts with no significant residual functional impairment in over 47 per cent of his cases.

Manipulation has been a widely used method of treatment. The most commonly used was the method described by Whitman. It is performed under full anesthesia and consists of forcible flexion and internal rotation followed by abduction of the thigh with simultaneous strong downward traction on the leg. In considering manipulation it must be remembered that leverage is great in this situation because of the long lever arm of the femoral shaft, and as a result pressure is exerted upon the small head. Manipulation must be very careful and gentle if trauma to the articular surface of the head is to be avoided as well as further trauma at the epiphyseal junction and damage to its blood supply. It is obvious that if slipping has progressed for a considerable period of time and repair processes have occurred rendering the malunion again fairly firm, manipulation will have small chance of success. The period in which good results may be obtained was placed variously at 2 months from onset by Ferguson and Howorth, not over 4 months by Brogden, while Bentzon felt that it would be successful up to 6 months from the onset of symptoms. The amount of displacement and callus formation as determined by roentgenography, is also a helpful guide. Pomeranz and Sloane (40) have pointed out that x ray films made following manipulation, with the leg in internal rotation, had given many surgeons a false opinion that reduction had been obtained, whereas actually there was only superimposition of the shadows of head and neck, and the deformity persisted. Waldenstrom was of the opinion that closed reduction under anesthesia should never be done because only a few of the so-called successful reductions showed improvement and in one-fifth of his patients so treated aseptic necrosis resulted. Many failures with this treatment have been reported, often with progressive loss of motion, and with pain in the hip following the procedure (1 14, 16 27 40 42, 43 44, 48). Good results have been obtained in early cases best in those with acute, early separations.

Perkins, Wardle, and others advocated traction and have obtained fair results. The question arises as to whether the results with surgical procedures are adequate to justify the attempt at correction of the deformity. Many believed that

there is constant danger of sudden, acute slipping due to a fracture through the weakened epiphyseal line. When this occurs the patient usually has sudden, severe pain in the hip, often accompanied by marked muscle spasm, external rotation of the leg, and marked limitation of all motions.

In those cases in which the gradual process continues, the patient's limp becomes persistent, often with increase of pain, although not necessarily so. The patient notices increasing weakness and fatigability in the affected extremity. Objectively the patient is seen to walk with a decided limp, with the pelvis tilted downward on the affected side and the gluteal fold lower on that side. A mild compensatory scoliosis develops with the lumbar curve toward the affected side. The trochanter is elevated on the affected side, usually lying above Nelaton's line. There is mild to moderate atrophy of the buttock and thigh. No tenderness can be elicited. The leg lies in external rotation and the patient, as he walks, holds it in this position. Internal rotation is sharply limited and there is usually a marked limitation of abduction due to impingement of the trochanter on the pelvic wall. A mild flexion deformity is often present. Active and passive motions are about equal. These patients generally show no other sign of illness of any kind, have no fever, have normal sedimentation rates, and appear quite healthy.

The danger of progressive displacement remains until the epiphyseal cartilage is completely ossified and is, therefore, present over a period of from 1 to 3 years from the time of onset. After ossification has occurred, there will be no further displacement. Due to irregularities of the displaced head and proximal end of the neck, and the poor fit in the acetabulum and possibly to damaged blood supply occurring in the process, with necrosis of overlying articular cartilages, these patients often develop residual arthritic changes at a variable period after reaching the final stage with healing of the epiphysis. Ghormley and Fairchild pointed out that the many cases of morbus coxae senilis probably represent residuals of old slipped epiphysis.

It has been pointed out by Key and others that the severity of symptoms does not always correspond to the anatomical deformity present, and that each case must be carefully considered individually.

#### TREATMENT

The variety of procedures employed in the treatment of this condition is evidence of the fact

that none is completely satisfactory. It was quite generally agreed, however, that the earlier treatment is begun the greater is the opportunity for success. The importance of early recognition and diagnosis and early institution of therapy was repeatedly emphasized.

In choosing the type of treatment to be instituted, an attempt must be made to determine as well as possible the pathological changes that have occurred. The duration of symptoms, the time since an acute displacement, the age of the patient, x-ray evidence as to the amount of displacement and extent of callus formation, and functional ability of the joint must be considered. For purposes of discussion the disease may be divided into several more or less arbitrary periods.

*Prdisipping or slight displacement.* At this stage there may be present only a widening of the epiphyseal line or if slipping has occurred, it is less than three-eighths of an inch or one centimeter. Patients seen during this period show the best results. It has been pointed out by Howorth, Milch, and many others that once changes begin, the epiphysis is likely to undergo premature ossification due to the damage it has sustained. The period required varied considerably in the reports of several authors, but may be as short as 8 to 12 months or slightly less. In some cases, however, it may extend for 2 to 3 years. The patients must be followed, regardless of the type of treatment used, until there is good x-ray evidence of ossification through the epiphysis and firm union between the head and neck. During this entire period they must be carefully protected from any strain likely to produce further slipping at the softened epiphysis.

Conservative treatment may consist of simple rest in bed with freedom from weight-bearing. However, acute slipping occasionally occurs at bed rest. Some authors have advocated rest, with walking permitted on a raised shoe on the sound leg, and crutches, or a caliper brace to avoid weight bearing. Such a brace with the addition of constant maintenance of internal rotation has been used with better results (32). The danger of added strain on the opposite hip with possible development of a bilateral lesion must be constantly kept in mind. Plaster of paris casts have been used for periods of 5 to 9 months, to maintain a position of abduction and internal rotation. In some cases efforts to avoid the excessive atrophy and tendency to stiffness of the hip have been made by bivalving the casts and using careful physiotherapy.

General measures such as weight reduction, elimination of foci of infection, the correction of

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they are not, reporting that better function was retained in untreated hips, even with deformity, than in those subjected to surgery even when good anatomical reposition was obtained. Howorth, in discussing the paper of Ghormley and Fairchild, stated "when the epiphysis has already slipped the chances of securing a good result are not good regardless of the method of treatment. Any type of reduction is poor treatment because the head must be entirely separated from the neck in order to obtain reduction. And when the head is completely separated from the neck most of the blood supply to the head is completely destroyed which will result in severe damage. The aim should be to avoid the necessity of an open operation." In general, the more radical the surgical procedure the poorer the end result.

Osteotomy has been performed in an effort to correct deformity of the leg. This may be either subtrochanteric, transtrochanteric or coneiform osteotomy of the neck. In the latter case great care must be taken to avoid destruction of the blood supply to the head, running in the capsule and synovial covering of the lower margin of the neck. Kleinberg and Buchman (18) reported good results from resection of the epiphyseal plate. Compere reported 14 cases of hips in which a wedge osteotomy of the femoral neck was done and the head fixed to the neck by means of multiple threaded wires. The average follow-up period was 2 years. One patient developed septic necrosis of the head, and one patient with bilateral slipping developed ankylosis in both hips. The remainder of the hips showed good results. He advocated a minimum of trauma and emphasized placing the head in a valgus position in relation to the neck before inserting the threaded wires.

**Sudden acute slipping.** If patients are seen early after the occurrence of acute slipping, the treatment of choice is gentle careful manipulation followed by immobilization, as the epiphysis is loose and may be maneuvered back into position. If not seen until repair has begun and malunion has occurred, the problem becomes the same as in the case of advanced, gradual slipping.

**Old residual cases.** In these cases ossification has been completed in a position of malunion of greater or less degree. Various reconstructive procedures have been performed, the results of which have been generally poor. Conservative palliative therapy is probably the method of choice.

Assessing the value of different methods of treatment from reports in the literature is somewhat difficult as there is a lack of uniformity in reporting. In some instances the duration of the lesion was not reported prior to treatment, in

others the follow-up period was too short, and in still others the degree of slipping was not given. Pomeranz and Sloane (40) have shown that deformity of the head and acetabulum with painful hips may appear as late as 5 years after apparently successful treatment. Many have reported a combination of several forms of therapy and in some cases it was simply stated that surgery was performed without specifying the procedure.

#### SUMMARY

Slipping of the capital femoral epiphysis is a condition which occurs during adolescence, probably comprising the most common cause of hip disability with onset in this age group. It is more common in males, with a ratio of 3 to 1 and coincident with the peak of adolescence, appearing somewhat later in males than in females. It occurs most commonly in the "overgrown," obese child or in the unusually tall child who has had a rapid growth in height.

The etiology has not been proved but probably the condition is due to an interaction of many factors, including anatomical changes at the joint at this period rendering it more susceptible poorly understood endocrine changes which may contribute to softening of the cartilage junction too rapid growth possible chemical imbalances and to other changes at adolescence which may in these patients be exaggerated beyond the normal. Trauma is usually the immediate cause of slipping.

The treatment is varied but its success depends upon the early recognition of the disease. These cases are rarely admitted to the hospital with a correct diagnosis. Our aim must be toward the education of all physicians who see patients of this age group, to consider this diagnosis, to recognize early slight physical signs and roentgen changes by careful comparison of the two hips, and to consider these patients as emergencies, instituting immediate treatment, to be continued with no lapse until closure of the epiphysis occurs and firm bony union is established between the head and neck of the femur.

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3 cm. in diameter that occupied the lateral two-thirds of the right supraorbital ridge and pushed the eyeball down and in. An uneventful postoperative course followed its removal. The specimen was pathologically diagnosed as a chronic granuloma sequent to organization of an old hematoma.

The second case was that of a chauffeur aged 44. In 1934 he was struck on the left temporal region near the orbit. In 1946 he noted a swelling about the left eye proptosis and diplopia, and a mass could be felt in the upper outer corner of the orbit. X ray examination showed a concentric, expanding lesion with rarefaction of the left frontal bone. At operation the affected bone which incised the orbital margin the superior orbital plate and the floor of the anterior fossa, was removed. The dead space was filled with fibrin foam and the wound was closed. A month later the fronto-orbital defect was repaired with a tantalum cranioplasty. In the final examination vision was R. 20/20 and L. 20/20 left hypophoria of 4 prism diopters no exophthalmos and no ocular complaints.

Radiologically the post traumatic granuloma simulates any osteolytic lesion involving the frontal bone. Surgically they are cured by radical therapy. Pathologically, the essential lesion is a chronic granuloma composed of granulation tissue containing abundant homogeneous pigment, multinucleated giant cells cholesterol crystals many fat laden phagocytes and a variable degree of fibrosis. When a hematoma occurs in a bone the broken down blood may act as a foreign body with a consequent slow steady reaction over several years.

JAMES E. LEBENSOHN M.D.

**Removal of an Orbital Tumor through the Inferior Route with Kuhn-Szymanowski Repair of Ectropion.** ALAN CALANAN *Sent. N. J.*, 1948 41 790.

A tumor mass that can be palpated over the infraorbital rim is best removed through an incision over the infraorbital rim and this method was used in the following case.

A woman aged 68 had noted proptosis of the left eye over a period of 27 years and in the last year the eye had become red and painful with profuse discharge and totally blind. Deep palpation between the eye and the infraorbital rim revealed a firm mass. An incision was made across the lateral half of the left lower lid and the orbital septum was then divided care being taken to avoid injury to the lateral can thus the infraorbital nerve and vessels and the origin of the inferior oblique muscle. The tumor was removed by finger dissection without injury to the ocular muscles and measured 3 cm. in diameter. The eye then returned to its normal position. The orbital septum was closed with chromic catgut, and the skin was closed with silk. Microscopic examination of the tumor proved it to be a hemangioma. Ectropion of the lower lid persisted and was corrected 6 months later by the classic Kuhn-Szymanowski operation.

JAMES E. LEBENSOHN M.D.

**Clinical Course of Glaucoma.** ADOLPH POSNER AND ABRAHAM SCHLOSSMAN *Am. J. Ophth.*, 1948, 31 915.

The present study is a correlation of 474 cases of glaucoma from private practice. In 373 patients the condition was primary. One hundred and fifty-eight patients have been followed for 5 years or longer. There were 71 eyes with acute congestive glaucoma, 140 eyes with chronic congestive glaucoma and 422 eyes with chronic simple glaucoma.

The authors attempt to consider the problem from a purely clinical point of view. Comparison of an isolated case of acute congestive glaucoma in which cure has been effected by surgical treatment, with a case of asymptomatic chronic simple glaucoma in which the tension is within normal limits or only slightly elevated, would seem to indicate that these are two separate diseases. However the authors state that analysis of a large number of cases invariably reveals gradations in the symptomatology and course to such an extent that a sharp line of demarcation cannot be drawn at any point in the series. Furthermore there is a mixed group of cases in which one may find either a congestive glaucoma in one eye and a chronic simple glaucoma in the other eye or a chronic simple glaucoma with acute exacerbations in one or both eyes. Additional evidence for assuming a unitary concept of primary glaucoma is found in a study of hereditary cases. In the same family tree one may find examples of congestive and chronic simple glaucoma.

Glaucoma should be regarded as a constitutional disease in the sense of a dysfunction of the central regulatory mechanism of the autonomic nervous system similar to the metabolic disorders such as diabetes hypertension and obesity. It is possible that this dysfunction constitutes the primary or at least the predisposing cause while the various anatomic and physicochemical conditions of the eye are modifying or precipitating factors. The fact that congestive glaucoma occurs in a small percentage of eyes with narrow angles and that this disease may also occur in eyes with wide angles tends to indicate that the angle plays a secondary role in the etiology of the disease.

The authors believe that although tension undoubtedly plays an important role in glaucoma there may be other factors which contribute to the cause of the disease. The following possibilities are suggested: (1) disturbance of the central autonomic nervous system (may include psychosomatic factors) (2) vasomotor instability (3) hereditary factors (4) arteriosclerosis (either general or local) (5) blood pressure (6) metabolic disturbances (diabetes, obesity endocrine) (7) relation of intraocular to intraocular pressure (8) degenerative changes in the nervous tissue (a) lacunary degeneration in the brain and nerve (b) Schnabel's cavernous atrophy and (c) local factors (a) anatomic (Schnabel's canal chamber angle retinal circulation choroid and so forth) (b) nutritional (c) congenital, and (d) physicochemical factors such as increased



# ABSTRACTS OF CURRENT LITERATURE

## SURGERY OF THE HEAD AND NECK

### EYE

Nature of Aqueous Humor. SIR STEWART DUKES-ELDER. *J. Am. M. Ass.* 943, 137-138.

Though the aqueous cannot be completely described by the mathematics of dialysis, it is certainly not, in the generally accepted sense of the word, a secretion. Cogan and Kinsey using heavy water as a tracer have shown a free two-way transference of water between blood and the intraocular fluids, and conclude that the water in the aqueous is renewed every 3 minutes. Friedenwald finds the current in Schlemm's canal is 1 to 2 cm. per minute and suggests a unidirectional permeability in the ciliary body through differences in oxidation reduction potential maintained by enzyme systems.

The experimental fact remains that the concentration of ions in the aqueous approaches a dialysate even more than other undoubtedly dialysates such as ascitic fluid. Slight deviations are susceptible of explanation. For example the change in carbon dioxide tension accounts for a difference of 1.5 per cent between the plasma chloride concentrations of arterial and venous blood.

The glucose in the aqueous is less than that of the blood by the amount utilized in the metabolism of lens and retina. It rises in the aphakic eye. Different sugars enter the aqueous in proportion to the size of the molecules. The disaccharide sucrose penetrates much more slowly than glucose and the trisaccharide, raffinose not at all.

Observation of radioactive isotopes shows that the most rapid entry into the anterior chamber is through the iris. Glucose penetrates the posterior segment at only one third the rate at which it reaches the anterior chamber, sucrose at one-seventeenth. The iris acts apparently like an inert diffusing membrane while the membrane in the posterior segment seems more selective.

Urea, creatinine, alanine and glycine enter the eye more slowly than the larger moleculous sugars. The blood-aqueous barrier is individualistic, and each constituent is treated in characteristic way.

There are then two mechanisms—a simple traffic through the iris mainly into the anterior chamber and a more discriminating one in the posterior segment.

JAMES E. LEXINGTON, M.D.

Intravitreal Streptomycin: Its Toxicity and Diffusion. P. A. G. REINTER, I. C. MICHAELSON, R. J. W. REES, AND J. M. ROBSON. *Br. J. Ophth.* 943, 3-449.

The author injected streptomycin subconjunctivally and intravitreally in a series of rabbits' eyes and found

1 Streptomycin injected into the vitreous of rabbits' eyes was diffused slowly throughout the eye, but had a deleterious effect on the retina. This was seen grossly and histologically.

2 Streptomycin injected subconjunctivally was not toxic to the eye but diffused rapidly out of the ocular tissue.

EARL H. MEER, M.D.

Craterlike Holes in the Optic Disc. EMANUEL ROSEN. *Br. J. Ophth.* 943, 331-365.

The author presents 7 cases of craterlike holes in the optic disc. He warns against confusing the diagnosis with glaucoma, since some patients have field defects, iris atrophy and pupillary inequalities. The cause for these pits is not known but it is possible that they are of congenital origin.

EARL H. MEER, M.D.

The Treatment of Severe Infected Corneal Ulcers by Subconjunctival Injection of Penicillin Twice Daily without Hospitalization; with a Short Review of Other Methods. KAMEL REIK. *Br. J. Ophth.* 943, 31-497.

The author presents a method of using penicillin subconjunctivally, twice a day, 10,000 units at a time in 0.5 c.c. of 1 per cent novocain solution for the treatment of corneal ulcers. The treatment was usually completed in a period of 5 days with excellent results.

This treatment was more practical, more efficient and more economical than the intramuscular use, instillation method, or subconjunctival injection every 4 to 6 hours.

The use of penicillin was then compared with older methods of treatment and found to be much better.

EARL H. MEER, M.D.

Post Traumatic Granuloma of the Orbit. G. STUART RAMSEY, H. WYATT LAWS, J. E. FRITCHEARD and HAROLD ELLIOTT. *Canad. M. Ass. J.* 943, 59-106.

Two cases of post traumatic granuloma of the bony orbit, simulating tumor are presented. A third case shows the identical pathological process in a rib. The literature contains only two previous instances of this rare condition.

The first case was that of a laborer 57 years of age. In 1913 his right supraorbital area struck the pavement in an automobile accident, with a proptosis of the right eye. X-ray examination showed a comminuted fracture of the margin of the right orbital fossa. Seven months later a tumor mass was noted fixed to the right frontal bone. The corrected vision was R. 20/50 L. 20/50 exophthalmometer, R. 19 mm., L. 22 mm., R. hypophoria of 5 prism diopters. A right supraorbital craniotomy revealed a tumor

United States Army general hospitals in England more patients were seen with blast injury of the ears than with any other injury or disease.

The studies reported here were made on 100 patients with acoustic trauma, admitted to this general hospital in the first 6 months after invasion of the European Continent in June, 1944. These were the first 100 patients who could be adequately studied although many others were seen and treated during this period. The patients not included in this series were eliminated because of other injuries which prevented audiometric examination or because they were under observation for too short a time. Many of these patients were seen within 1 week of injury but none before the third day. Some of them remained under observation for as long as 3 months. The findings in these men were deafness, tinnitus, interstitial hemorrhage and rupture of the tympanic membrane and acute suppurative otitis media.

Whispered voice tests and audiometric studies were done on all these patients and were repeated at intervals to follow their progress. A rough determination of the acuity of hearing for speech can be obtained by the whispered voice test. Audiometry is a much more accurate method evaluating and following changes in the loss of hearing for sound. This is borne out by a comparison of the findings by audiometry with those obtained by whispered voice and tuning fork tests.

A history of aural disease which existed prior to the blast injury was given by 25 of these patients. Six had total unilateral deafness, 11 had partial deafness and 9 had healed acute suppurative otitis media. Four gave a history of both deafness and previous aural suppuration.

Seventy per cent of the injuries were caused by high explosive shells. In some cases there had been repeated exposure to blast and heavy firing but no acute injury occurred.

The impairment of hearing was severe in 14 patients, moderate in 15 and slight in 71.

**Prophylaxis.** No satisfactory mechanical method of protecting the ears against blast injuries was in common use in World War II. None of the patients whose cases are reported used any means of protection. The reasons given for this neglect were summed up by Guild who stated that (1) dry cotton is ineffective in stopping even moderately intense detonation waves, and that (2) cotton soaked with oil or petrolatum and solid obturators are entirely unsuitable for use by those whose duties require that they be able to hear ordinary sounds well at all times.

**Tinnitus.** Inflation of the eustachian tube did not influence the tinnitus. No specific therapy was used in treating patients for this symptom.

**Rupture of the tympanic membrane.** Most of the smaller perforations healed without intervention. Occasionally it was necessary to stimulate the margins of the perforation by mild scrubbing or by applying 10 per cent silver nitrate to the margins of the perforation to stimulate healing. Marginal perforations appeared to close more slowly than the others.

Large perforations with damage of the ossicles showed no tendency to heal. Most of the perforations that healed did so in less than 1 month.

**Acute suppurative otitis media.** The prophylactic treatment impressed on the medical officers in the forward areas was the preventing of contamination of the ears by absolute avoidance of syringing or of applying drops to the ears. Not one of the patients in this series received injudicious aural therapy in the forward areas. The patients themselves had to be instructed not to contaminate their ears. In the presence of a dry traumatic perforation none of the sulfonamide powders was insufflated because it was felt that there was no advantage to be gained. Many of the patients had other injuries and were treated with sulfadiazine or penicillin or both a short time after being injured.

The active treatment was a daily cleansing of the infected ear with hydrogen peroxide and dry wipes, followed by instillation of one of the following local medicaments: sulfathiazole sodium solution (5 per cent), penicillin solution (containing 100 units per cubic centimeter), sulfanilamide powder or 2 per cent boric acid in alcohol. Sulfadiazine or penicillin was frequently used systemically in addition to the local therapy. These infections responded rapidly to treatment. In none of the patients did acute mastoiditis or other complications develop.

Thirteen case histories are reported accompanied by their audiometer charts. JOHN F. DELZ, M.D.

**A Newer Concept of the Management of Orogenic Infection.** MERRILL B. HAYES and C. FREEMONT HALL. *Arch. Otolaryng.*, Chic. 1948 47 289.

The authors believe that otologic infections in temperate zones can be divided into a winter phase during which gram positive organisms predominate, and a summer phase during which gram negative organisms predominate as the infecting agent. In the former type treatment has been practiced successfully with penicillin and other antibiotics. In the treatment of the latter difficulty has been encountered by many and in the past has not been successful. In an attempt to improve the treatment of gram negative otologic infections the authors studied a group of 100 cases exhibiting acute otitis media, chronic suppurative otitis media and otitis externa. In many of these, particularly in patients with otitis externa, the usual forms of treatment brought about the disappearance from the culture, of all bacteria except from the gram negative *Pseudomonas aeruginosa* (*Bacillus pyocyaneus*) and *Bacillus proteus* types.

After trying many compounds the authors found in the early part of their study that the most effective compound against the gram negative bacteria was monobromosaligenin. Later dibromosalicylaldehyde was found to be equally as efficacious as monobromosaligenin and, in addition this drug was active against fungi. Dibromosalicylaldehyde was considered the drug of choice. The two substances were used locally as a powder or ointment, or in solu-

capillary permeability and diminution in cholinergic substance.

In 60 per cent of the cases of primary glaucoma the onset occurred between 41 and 60 years of age. Fifty patients showed hereditary tendencies. The pedigrees studied exhibited dominant inheritance.

MICHAEL LOUVALIAN, M.D.

**Green Spectacles Prescribed in Glaucoma.** R. B. ZARETSKY. *Am. J. Ophth.* 948, 31 935.

It has been shown that the illumination of an eye with green light resulted in the lowering of the intraocular pressure in the other eye this effect being especially pronounced in glaucomatous eyes. It seemed natural, therefore, to test the use of green spectacles as a means tending to reduce intraocular pressure. Experiments were carried out on 19 subjects, with a period of observation varying between 12 to 15 days for hospitalized patients and 30 or more days for out patients.

From an analysis of curves obtained, it may be said that notwithstanding the total suspension of pilocarpine medication the intraocular pressure showed a pronounced tendency to decrease in patients wearing green spectacles the range of fluctuations of intraocular pressure during the day was likewise found to decrease. An appreciable effect was obtained when the use of green spectacles was combined with the administration of very small doses of pilocarpine (0.5 per cent solution twice daily). The decrease in intraocular pressure was much more striking however in certain cases in which the use of green spectacles was combined with small doses of adrenalin.

Green light, while acting upon the color receptor of our vision produces a definite rearrangement in the vegetative nervous system, thus also affecting the neurovascular apparatus of the eye. We may assume that the amounts of acetylcholine and sympathin in the eye are different according to whether the eye is exposed to red or green light.

The encouraging results of the experiments cause the author to believe that the use of green spectacles may in certain forms of glaucoma, prove a helpful therapeutic procedure especially if prescribed along with small doses of adrenalin or pilocarpine.

MICHAEL LOUVALIAN, M.D.

**Beta Irradiation in Glaucoma.** GEORGE M. HAIR, L. A. BREITZEL, and AXLETA BARRER. *Am. J. Ophth.* 1948, 31 945.

The authors conducted a series of experiments in which beta irradiation was applied to the ciliary body of rabbits in varying amounts over varying periods of time in an endeavor to determine the practicality of treating glaucoma by obliteration of the vascular supply of the ciliary body with the objective of bringing about a decrease in the production of intraocular fluid. The experiments reported were planned in the light of changes in the vascular endothelium, leading to proliferation and various degrees of occlusion of the lumen which have been reported

after beta radiation, and which are most marked in the endothelium. While vascular changes were achieved in the majority of cases, damage to the lens also resulted in almost every instance in which the desired changes were accomplished.

The proposed method seems theoretically sound, however to make it practical, a dosage of radium must be established which will bring about the desired changes in the ciliary body without damaging the lens at the same time. Probably this objective could be accomplished if an applicator were available which would permit the emanation of beta rays but would screen out gamma rays.

A clinical case is presented in which irradiation was employed because the state of the eye was already practically hopeless. Apparently the treatment has produced no ill effects, but the therapeutic results are still inconclusive.

MICHAEL LOUVALIAN, M.D.

**Operative Failures for Chronic Glaucoma.** BRIT TAIN F. PAYNE. *Am. J. Ophth.* 948, 3 1065.

A study of eyes removed after operative failures for chronic simple glaucoma shows that ideal surgical relief has not been devised so far as the laboratory is concerned. The examination of approximately 100 eyes operated upon for glaucoma at the New York Eye and Ear Infirmary showed at least three characteristics: (1) adhesions between the iris and the cornea, (2) closure of new filtration channels with fibrosis and (3) inflammation of the uvea. Synechia between the anterior surface of the iris and the posterior surface of the cornea are composed of such dense connective tissue that permanent separation by operation is almost impossible. The artificial filtration channel, or channels become closed by the proliferation of connective tissue despite an iris inclusion in the operative wound. Progressive iridocyclitis usually requires enucleation. Operations for glaucoma performed on globes sent to the laboratory are iridectomy, iridencleisis and trephination.

Common pathologic changes are present in eyes removed after operative failures for chronic simple glaucoma. A comparison of the histology of normal eyes with that of chronic simple glaucoma may reveal the causes of operative failures. Failure of iridectomy may be due to the persistence of synechia and to failure to remove the iris at its roots. In iris inclusion operations the iris itself may produce closure and in trephinations closure may occur as the result of fibrotic and inflammatory changes.

MICHAEL LOUVALIAN, M.D.

## EAR

**Blast Injuries of the Ear.** ORREL FRIEDMAN. *Arch. Otolaryng.* 948, 47 47.

The confusion or blast produced by the high explosives used in modern warfare is greatly injurious to the auditory apparatus. This fact quickly became obvious to an otolaryngologist treating battle casualties in World War II. On service in one of the

## PHARYNX

**The Uvula: Its Structure and Function and Its Importance.** GEORGE S. RICHARDSON and E. MARKEY PULLEN *Arch. Otolaryng.* 1948, 47 379

On the whole there is no structure within the confines of the body so little understood and so often abused and maligned as the uvula. This structure's function appears in the literature in only the briefest fashion. The uvula has been classed with vestigial structures such as the vermiform appendix.

In the present article, the authors delve deeply into the anatomy of the nose and soft palate as related to the uvula. This is illustrated by 4 anatomical drawings by one of the authors.

The functions of the uvula are summarized as follows:

It massages and moistens the cellular structure of the posterior pharyngeal wall. It aids in the removing of material from the posterior pharyngeal wall and in the passing of this material downward to the hypopharynx and the base of the tongue. It serves as a transfer organ to bridge the deficiency between the velum and the posterior pharyngeal wall as secretion moves from the midline above and anteriorly to the midline posteriorly. It is a valuable aid in preventing middle ear disease in children by participating in the preservation of normal pharyngeal arches. The uvula prevents pharyngitis sicca with subsequent drying of the eustachian orifices as might be expected with a high arch on one side or with a fibrous straight line contracture. It is the warning flag of the pharynx in many instances. It prevents rhinolalia aperta in successful tonsillectomy and is a valuable adjunct to voice control, possibly as a midline buttress, particularly in singers. This function is of little value in the speaking ranges apart from preventing unpleasant qualities. A uvula deviating to one or the other side may indicate a weakness of the accessory nerve on the opposite side.

The conclusions reached are as follows:

The uvula is a valuable means of preserving and detecting nasopharyngeal health and change. It should not be traumatized needlessly nor should it be subjected to operation unless a definite syndrome traceable to it is evidenced.

More must be known about the eustachian tube and its nasopharyngeal orifice before one becomes willing to sacrifice a uvula, or to class it as a vestigial

remnant. To ignore an edematous uvula is as negligent as to ignore chronic hoarseness without ascertaining the state of the vocal cords by viewing the anterior commissure in indirect laryngoscopy.

Case histories are presented to illustrate certain points in the text, such as the influence of the uvula on the health of the nasopharynx and its influence in reinforcing the soft palate in voice control.

JOHN F. DELPHE, M.D.

## NECK

**Lymphadenoid Goutter.** H. M. GOLDBERG and J. DAVISON *Brit. J. Surg.* 1948, 36 41

The authors endeavored to find out, first, whether it is possible to differentiate clearly between thyrotoxicosis or simple goutter with lymphocytic infiltration on the one hand and lymphadenoid goutter on the other and, secondly, to determine whether a study of the relationship between the two conditions can throw any light on the etiology and development of lymphadenoid goutter.

They conclude that no sharp dividing line can be drawn on histological grounds between toxic goutter with lymphoid infiltration and established lymphadenoid goutter; the differences appear to be essentially ones of degree.

They further believe their study has shown that focal changes histologically indistinguishable from those seen in the various stages of lymphadenoid goutter can very frequently be found in the rim of thyroid tissue immediately surrounding an area of adenomatous hyperplasia, and also immediately beneath the fibrous tissue capsule of the gland. Both locations are sites where compression of thyroid acini would be liable to occur as the result of increase in size of part or whole of the gland. They believe it is reasonable to conclude that the changes are secondary to local ischemia, and it is suggested that the widespread changes occurring in lymphadenoid goutter are similarly due to ischemia, probably a relative ischemia due to the blood supply being insufficient to meet the increased demands created by the stimulation of the thyroid epithelium by the thyrotropic hormone. The fact that the changes are never seen inside an area of adenomatous hyperplasia, which for its growth and maintenance depends on an adequate blood supply, is considered further support for the ischemic causation of the lymphadenoid changes.

EARL O. LATIMER, M.D.

tion, as adjuncts to penicillin and the sulfonamides. Streptomycin was not used. Eight tables are given.  
JOHN J. BALLENGER, M.D.

**Bone-Dust Free Lempert Fenestra Nov-Ovalis: A New Evolutionary Development of the Surgical Treatment of Clinical Otosclerosis.** JONAS LEMPERT. *Arch. Otol. Chlc.*, 1948, 47: 280.

In the surgical treatment of clinical otosclerosis, bone sand and bone splinters have always been the by-products of fenestrating the bone labyrinthine capsule with the electrically driven burr. When the final endosteal bony layer in this operation is fractured inward, the author believes that bone dust and splinters are almost invariably lost within the perilymphatic space and their presence there enhances the tendency to osteogenesis that exists at the fenestral rim. Failure to remove these particles, according to the author, may lead to postoperative closure of the fistula. However, he points out that attempts at removing the bone splinters may inadvertently involve injury to either the perilymphatic trabecular blood vessels, with resultant hemorrhage in the perilymphatic space, or to the endolymphatic labyrinth.

At the time of re-operation in cases in which the gain in hearing was not maintained, the author observed new bone formation involving the fenestral rim or involving both the fenestral rim and the perilymphatic space. He reasoned hypothetically that perhaps the perilymphatic endosteal osteogenetic process which he observed in the human subject had been initiated by bone fragments that found their way unnoticed into the perilymphatic space. In order to avoid such an occurrence, a technique for fenestrating the surgical dome of the vestibule without creating bone splinters and dust was evolved. This is done by removing the bony surgical dome of the vestibule until only the endosteal bony layer remains. An incision is then made through the endosteal bone to outline the fistula. The cap thus created is everted and removed intact, exposing the endolymphatic labyrinth. Finally the fenestral rim is burnished with a lead burr. In this way the author believes, injury to the endolymphatic labyrinth and perilymphatic trabeculae is avoided, and the formation of bone dust and splinters is also avoided.

Ten figures of microscopic sections, and a number of drawings are included.

JOHN J. BALLENGER, M.D.

**Chorda Tympani Nerve Graft: A Preliminary Report of a New Technique Used in Surgical Penetration of the Labyrinth.** SAMUEL ROSEN. *Arch. Otol. Chlc.*, 1948, 47: 428.

Otologists are indebted to Lempert for the first practical one-stage technique for the surgical treatment of clinical otosclerosis. However, significant numbers of failures continue to be a challenge to the surgical techniques developed therefrom. The two most important causes of failure appear to be bony or fibrotic closure of the fenestra and postoperative membranous labyrinthitis of varying degrees. Anal-

ysis of these factors had led Lempert and Shambaugh to introduce modifications of the fenestration technique in an attempt to increase the percentage of successful cases. Possibly the amount of auditory improvement could be increased to an even higher level in successful cases if the degree and the duration of the postoperative labyrinthitis could be diminished.

The chorda tympani nerve is liberated from its attachment to the facial nerve and is placed over the fenestra to protect the membranous labyrinth and the perilymphatic space from the untoward effects of blood and inflammatory products coming mostly from the overlying tympanomeatal flap. The chorda seems eminently suited to play the role of protective barrier to the delicate labyrinth since it withstands successfully all degrees of acute purulent otitis media to which it is exposed. Taste on the anterior two-thirds of the tongue is not affected in acute purulent otitis media. It is interesting to note that in its tympanic course the chorda tympani nerve is covered with mucous membrane.

A myringotomy knife is inserted between the chorda tympani nerve and the inner surface of the tympanic membrane. The blunt edge of the knife is swept upward beyond the point at which the chorda is attached to the neck of the malleus. In a similar manner the myringotomy knife is swept downward to the region where the chorda enters its bony canal. The chorda, covered by mucosa, is then grasped with a jeweler's tweezers about 3 to 5 mm. below the malleus. Traction upward with the tweezers is continued until the chorda is pulled out of its bony canal. The free length of the chorda is then placed safely in the tympanum until the fenestra nov-ovalis is completed. Then the chorda is placed over the middle of the length of the fenestra from above downward. In this position the chorda tympani lies on the delicate membranous labyrinth with only the very slightest perilymphatic space visible on each side of the nerve. As the chorda is being pulled out of its canal, great care is necessary to avoid tearing it before its free end is long enough to reach and cover the fenestra. When the chorda has been completely evolved from its attachment to the facial nerve it may be long enough to be looped back up alongside and parallel to the descending portion of the chorda. This double length of chorda tympani covers the fenestra completely. The tympanomeatal flap is then put in place.

Eight cases are reported. Within 3 weeks after the operation, all patients had a decibel loss of 15 or less. Hearing continued to improve rapidly, and by the fifth week following operation the majority had a decibel loss of 15 or less. This level of hearing has been maintained or improved to date.

Thus far osteogenic closure of the fenestra has not occurred in any case. It is too early to predict to what degree, if any, the chorda tympani graft may succeed in preventing osteogenesis.

The article is illustrated with 4 figures and 3 tables.

JOHN J. BALLENGER, M.D.

number of British and American authors since this surgical procedure was first used by Monus and Lima, in 1936. They perfected 7 different types of bilateral incision in the frontal lobes made by an approach through the temporal fossa. The opening in the skull is situated 3 cm behind the lateral orbital margin and 3 cm above the zygoma, allowing identification of the area of the brain exposed by the position of the Sylvian vessels. The authors use the MacGregor Crumhly leucotome and claim to be able to perform smaller and more selective leucotomies. They state that their upper incision of the white matter leads to improvement in patients with psychomotor activity, and suggest orbital leucotomy in the passive and emotional states. GEORGE PERRET M D

**Cushing's Disease with a Hyperplastic Basophil Cell Tumor of the Hypophysis** (Maladie de Cushing avec tumeur hyperplasique a cellules basophiles de l'hypophyse) HENRI METZGER, LOUIS FROMLING, and MARCOURITE MESCHONCOS. *Ann endocr Par* 1948 9 35

This article is really a case report of a 52 year old single woman with symptoms pointing to a Cushing syndrome in whom a complete postmortem examination was carried out. There was a small tumor in the anterior lobe of the pituitary gland which was composed principally of basophil cells. The patient had menstruated regularly up to the age of 50 years. She was small in stature and had a round hirsute face with bilateral exophthalmos. She had a heavy abdomen and thin spindling extremities. Her chief complaint was cramps in the legs when walking. The blood pressure was 220/180 and the electrocardiogram showed there was severe left ventricular strain. There was some kyphosis in the thoracic spine. The posterior clinoid processes were destroyed. In addition to the findings in the hypophysis there was evidence in the kidneys of a malignant nephrosclerosis.

The author distinguishes between Cushing's disease and Cushing's syndrome. The syndrome can be produced by extrapituitary lesions such as adrenocortical tumors or tumors of the thymus or ovary. The bibliography is very small and does not entirely cover the work of the authors quoted.

ADRIEN VER BRUGHEM M D

## SPINAL CORD AND ITS COVERINGS

**A Contribution to the Knowledge of the Conus and Filum Ependymoma.** LENNART ZETTERGREN. *Uppsala lak foren. forh* 1948, 5 11

Quoting reports from the Mayo Clinic, the author states that approximately every fifth tumor of the central nervous system is a spinal cord neoplasm and that among a group of 557 intraspinal tumors 64 were intramedullary. Of these 64 33 were ependymomas or ependymoblastomas and approximately 50 per cent of them were located in the filum terminale in the lowermost portion of the true spinal cord. Two illustrative case histories are given. Quoting Kernohan and others, he lists these tumors

under several types—epithelial, myxopapillary and cellular types of ependymomas.

The clinical symptoms of tumors in this part of the root or conus are characterized by pains of a sciatic type, weakness and numbness in the lower extremities and incontinence of urine. The symptoms usually developing in that order. He believes that myelography is extremely valuable in the topographical location of the tumor.

JOHN MARTIN M D

**Diagnostic Puncture of Intervertebral Discs in Sciatica.** K. LINDBLOM. *Acta orthop scand* 1948 17 531.

The author's rather unorthodox procedure described in this article consists of the fluoroscopic control of the needle point when a spinal puncture needle is passed through the interspinous space through the dural space on through the posterior longitudinal ligament, and into the intervertebral space where a ruptured disc is suspected to be present. Some such contrast medium as diodrast is injected. By means of this method he has been able to demonstrate the actual disruption of the disc between the vertebral bodies showing the direction and nature of the posterior or posterolateral protrusion through the canal of rupture. He states that so far the indication for a diagnostic disc puncture is long standing sciatica, which was not improved by conservative treatment and which had been myelographed by a brodil without definite localization of the disc protrusion. This procedure was first done on cadavers and the excellent visualization of disc lesions on such specimens led to applying the same procedure to the living subject.

Apparently the author does not believe that the clinical signs and myelography although corresponding to the localization of the level of the lesion are 100 per cent reliable evidence. The possibility of injury to the roots of the cauda equina by this procedure is only briefly mentioned by the author.

JOHN MARTIN M D

**The Bladder in Spinal Cord Injuries** (La vessie des traumatismes medullaires) R. CAILLOUX and G. PELOT. *J. urol med.*, Par 1948 54 101

After reviewing the anatomy of the bladder the authors discuss the physiology of micturition. They recognize a center of controlled micturition regulating the striated muscles, a center of automatic micturition in the lumbosacral segment of the cord regulating the nonstriated bladder musculature and a center of automatic micturition within the bladder wall. In the infant, micturition is produced by a reflex mechanism involving the automatic center only while in the adult the desire to urinate becomes conscious, the automatic center is controlled consciously by the higher center which also activates the striated bladder muscles. Willful micturition is dependent on the action of the striated sphincter muscle. The automatic system regulates the action of the detrusor muscle responsible for the expulsion of the vesical content and also of the nonstriated internal

# SURGERY OF THE NERVOUS SYSTEM

## BRAIN AND ITS COVERINGS; CRANIAL NERVES

**Tantalum in the Repair of Traumatic Skull Defects.**  
WALPOLE LEWIS, M. P. GRAMM, and G. B. NORTHCOTE. *Brit. J. Surg.* 94:8, 36 26.

A comprehensive review is given of 128 cases in which tantalum cranioplasty was performed and a 5 year follow-up on 124 of these patients is included. The indications for repair the preparation of the plate, and the operative technique are considered for each type of case however, the discussion of the results obtained is perhaps of greatest interest.

Uncomplicated postoperative convalescence was observed in 120 of the 128 patients, with no immediate mortality. Persistent collections of spinal fluid beneath the scalp were noted in 3 patients, pressure necrosis with scalp infection occurred in 1 patient, coliform meningitis developed in 1 and in 3 patients with associated frontal defects, the cosmetic effect was poor. Ten patients developed epilepsy within 2 weeks after operation, half of whom had had pre-operative seizures.

Late results were judged primarily on the basis of answers 124 patients gave to a questionnaire, or on the basis of a supplementary letter from the patient's physician. Three patients died within the follow-up period. One had developed status epilepticus and died shortly after the removal of the plate, a second presumably died of recurrent meningitis in a mental hospital 1 year after plating and a third succumbed to pneumonia unassociated with his cranioplasty.

Removal of 11 plates had to be carried out. In 3 cases this was because of poor cosmetic results, 5 were removed because of infection and 4 because of intracranial complications. The authors point out that the one-stage preformed plate method has definite limitations in the frontal regions, for of the 68 patients with defects in this area, 8 were regarded as having an unsatisfactory result. Only 3 of these cases were thought to be complete failures, however. In all, only 7 per cent of the patients reported any local discomfort or pain as far as the plate itself was concerned.

Infection in the original wound had caused delayed healing in 31 patients in the series.

After evaluating these cases it was the authors' opinion that with proper chemotherapy repair of infected wounds can be safely carried out 3 months after final healing of the wound. The incidence of infective complications referable to the tantalum plate was 7 per cent but when the plate was related to a defect in the frontal sinus there was an additional 9 per cent risk in infection. Intracranial complications required removal of the plate in 4 cases. In one of these there was an underlying abscess in 3 others symptoms were due to hydrocephalus. In this latter group there was the sug-

gestion that tantalum in contact with the ventricular system may actually stimulate the production of cerebrospinal fluid hence close attention must be paid to repairing all dural tears or defects. Fifty one of the patients had had convulsive seizures, and the only ones in this series who showed improvement in their epilepsy were those on whom an intracerebral operation had been performed in association with the cranioplasty. A very complete discussion of late sequelae is presented and numerous interesting cases are cited in detail.

RICHARD C. SCHWEIDER, M.D.

**Differential Diagnosis of Tumors at the Cerebellopontile Recess.** ANTONIO GONZALEZ REVILLA. *Bull. Johns H. Sp. H. Hosp.* 94:3, 83: 87.

The author presents a review of 203 tumors of the cerebellopontile recess observed at the Johns Hopkins Hospital, Baltimore from 1926-1945 and verified at operation. Seventy-eight per cent of these tumors were acoustic neuromas. The remainder were cholesteatomas, meningiomas, gliomas, abscesses and miscellaneous tumors such as sarcomas of the meninges, malignant melanomas and carotid body tumors. The relationship of angle tumors to pain similar to that present in idiopathic trigeminal neuralgia is discussed.

It was found that the meningiomas occurred in a higher age group, that the seventh nerve is more commonly affected, and that radiographic erosion of the internal acoustic meatus is more rare in the presence of meningioma of the angle than when an acoustic neuroma is present.

Cholesteatomas are more apt to appear in a young age group, the duration of symptoms is longer and the resulting headaches are not as severe as those of an acoustic neuroma.

Acoustic neuromas are more likely to produce severe unilateral seventh and eighth nerve changes than do the gliomas, but differentiation between an angle neuroma and a glioma is frequently difficult.

The abscesses usually are accompanied by an occult history or the presence of a known pyogenic focus elsewhere in the body. Frequently Gradenigo's syndrome may precede the symptoms of an abscess in the angle.

The metastatic lesions are apt to occur in older individuals, the neurological symptoms are usually more widespread, and especially does the rather late appearance of the patient's difficulties exclude a tumor arising within the eighth nerve.

JOHN MARTIN, M.D.

**The Operation of Prefrontal Leucotomy.** E. CUNNINGHAM DAX and E. J. RADLEY-SMITH. *Brit. J. Surg.* 94:8, 36 74.

The authors describe the various approaches and techniques of prefrontal lobotomy devised by a

flowing. If residual urine is present, bladder neck resection may help. However, in these cases renal function is easily disturbed and no method of treatment is satisfactory. Cystotomy must be performed if signs of kidney damage are present.

The most frequent urinary complications in paraplegics are cystitis and ascending and hematogenous pyelonephritis. They are often associated with bladder stones and are more frequent in bedridden patients. The G and M solutions may dissolve or reduce the volume of the calcium carbonate and calcium phosphate calculi. However, the larger calculi must be removed surgically. Streptomycin may help when penicillin or the sulfonamides do not succeed, but it rarely stops an infection if a bladder stone or a suprapubic fistula is present. The prognosis of urinary infections in paraplegics remains poor.

GEORGE PERRET, M.D.

### PERIPHERAL NERVES

**Tensile Strength of Human Nerves: An Experimental Physical and Histologic Study.** C. T. LIO, C. E. BENDA, AND F. H. LEWIS. *Arch. Nerv. Psychiat. Chic.*, 1945, 59, 322.

These authors have performed a very useful function in publishing the results of their obviously carefully made experiments on the tensile strength of human nerves. Their material consists of 22 human nerves—3 sciatic, 4 ulnar, 7 tibial and 8 peroneal—which were removed from cadavers 6 to 12 hours after death when death was in no way related to any condition of the nerves.

The authors are aware of other optimistic reports concerning the stretch capability of human nerves but they feel that the important question is not when complete rupture occurs but at what force damage to single nerve fibers first appears and this they have demonstrated very well by means of a simple tensiometer. Their methods and statistics, neither of which are complicated, show that herniation of the nerve fibers through the sheath begins in the sciatic nerve at a 21 per cent stretch and in the peroneal nerve at 16 per cent. They demonstrated to their own satisfaction that the actual tension expressed in kilograms per square centimeter of the tested nerve, is not so good a guide to nerve damage as the actual percentage of stretch produced. One of the ulnar nerve specimens stretched 4.7 per cent under a tension of 15.3 kgm. per square centimeter and in this specimen two of the three main fascicles composing the nerve were ruptured while the third fascicle showed minor damage at different levels. The endoneurium is apparently less elastic than the perineurium and often is torn transversely together with the nerve fiber bundles. The endoneurium was torn at about 20 per cent stretch. Microscopic hemorrhages were frequently noted about the endoneurial vessels. The nerve fibers in most cases were observed to be completely interrupted when the nerve was stretched beyond 20 per cent. The myelin sheaths were frequently fragmented.

Apparently the axis cylinder and myelin are the least resistant to stretch, whereas blood vessels in the endoneurium and perineurium are more resistant. The authors believe therefore that no human peripheral nerve should be stretched more than 6 per cent of its length, beyond which point severe internal microscopic fracture occurs in various places. Under such conditions the degree of recovery will be greatly minimized. The significance of their findings is important in the repair of severe peripheral nerve lesions during which the effect of stretching may not be known to many surgeons. JOHN MARTIN, M.D.

**Post Traumatic Ossification of the Peripheral Nerves. Histogenetic Study of Heterotopic Osseous Neoformations (Ossificazioni posttraumatiche dei nervi periferici. Studio sull'istogenesi delle neoformazioni ossee eterotopiche).** LEONARDO GUL. *Chir. org. movim.* 1948, 32, 241.

The author presents 7 cases in which calcification developed in and about the cicatricial regions of an injured nerve. Microscopic studies were made of the removed osseous neoformations. Three of these patients had suffered injury to the sciatic nerve (1 with and 2 without associated fracture), 1 patient had an injury of the median nerve, 2 patients had suffered injury to the radial nerves without associated fracture and 1 patient had suffered an injury to the axillary nerve with associated fracture of the clavicle. The osseous processes were of no special significance as the nerve tissues themselves did not take part in the abnormal process of calcification and the newly formed bone was easily removed without any effect on the ultimate outcome of the case.

Microscopic study of the removed tissues demonstrated that the osseous tissues in each case were entirely independent of the neighboring bone apparently taking origin from the cicatricial changes between the ends of the injured nerve or from the tissues of the perineurium.

From his studies of the tissues in this group of cases the author is led to regard the theory of cellular new bone formation as postulated by Lenche and Polycard (wherein the lime salts are laid down directly within the meshes of the collagen fibers of the connective tissue without any participation on the part of the connective tissue cells themselves or cells derived from elsewhere in the body) as not adequately explaining all the findings observed in these cases. For the general process of osteogenesis the clarifications of S. Kromprecher (*Die Knochenbildung*, G. Fischer, Jena, 1937) are accepted as embodying the classical opinions on the subject. With this theory the process of ossification is mediated by special cells (reserve cells) which normally lie dormant among the connective tissue cells until roused to form osteoblasts by the stimulus of the injury or of some other unknown factor. However, Kromprecher's clarifications are not accepted in full. It is the author's impression that these osteoblasts arise as a transmutation of young connective cells.

JOHN W. BRENNAN, M.D.



sphincter fibers responsible for urinary retention. The innervation of the evacuation musculature is parasympathetic and is transmitted through the nervi erigentes. The sphincter tone is sympathetic and secondary and is supplied through the two branches of the hypogastric plexus fibers originating in the sacral ganglia and accompanying the nerve erigentes and periauricular sympathetic fibers. The afferent sensory pathway of the micturition reflex is also formed by the parasympathetic nervi erigentes and their posterior roots. Thus the parasympathetic system controls sensation and emptying of the bladder and the sympathetic system regulates bladder continence and ejaculation and also has a trophic and a secondary extraperitoneal sensory function.

The paralyzed bladder of the paraplegic shows retention during the initial period of medullary inhibition or spinal shock, and in the later phase of spastic paralysis it develops reflex contractions which become very useful in the development of automatic micturition. The authors state that in the initial flaccid stage the muscles controlled by the automatic and voluntary centers are paralyzed while the sphincter tone controlled by the extramedullary ganglia of the sympathetic chain is not decreased but increased. The noncontracted sphincter musculature is therefore spastic and urinary retention results. The intravesical pressure increases and eventually overcomes the internal sphincter and produces passive incontinence because of overflow.

The classical treatment of the distended bladder by repeated catheterization or continuous drainage often results in vesical, urethral or periurethral infections, while early cystostomy does not allow complete drainage and may be responsible for infection due to urinary stagnation. Modern treatment consists of manual expression of the bladder contents. When not contraindicated by urethral obstructions or ruptures this method enhances the development of spontaneous contractions of the bladder and restoration of micturition. The bladder does not become infected. If this procedure is not practicable tidal drainage is the other method of choice. Various isotonic and antiseptic solutions may be used and introduced into the bladder at a rate of 60 drops per minute. The intravesical pressure can be adjusted to the tonicity of the bladder. The catheter should be changed every 6 days. When automatic micturition is established, tidal drainage should be discontinued if the residual urine is not more than 100 c.c. but continued if it is over that amount. By weekly cystometry recovering function of the bladder can be studied. The catheter can be removed if intravesical pressure of 25 mm. of mercury produces a contraction of the bladder.

Controlled micturition may be regained only in the cases of partial cord lesions. Complete cord transection results only in reflex urination. Tidal drainage is of no value in low cord lesions in which the bladder will remain atonic, or in cervical lesions. It is also contraindicated in urethral or prostatic infections or inflammations. When cystostomy is nec-

essary tidal drainage can be applied if the bladder opening is small. Occasionally tidal drainage must be replaced by two daily irrigations of the bladder through an indwelling catheter.

As soon as the paraplegic patient enters the spastic stage recovery of bladder function can be better evaluated. In partial cord sections nearly normal controlled micturition can be obtained provided half of the spinal cord is intact. In complete physiological or anatomical cord transection micturition becomes automatic if the lesion is above the medullary center of Budge in the lumbosacral segment of the cord. Although the afferent sensory pathways are paralyzed many patients have a sensation of fullness when the bladder is full. This sensation is transmitted by retroperitoneal sensory sympathetic fibers. The automatic urinary reflexes can be induced voluntarily by some patients by compressing the glans penis or pinching the internal aspect of the thighs. Thus, in accord with the site of the lesion and the intelligence of the patient, automatic micturition may be disciplined and controlled to a certain extent.

In cases of destruction of the conus medullaris or complete transection of the cauda equina, automatic micturition develops and results from the function of the ganglia within the bladder wall alone. The bladder and sphincter muscles become hypertrophic, the bladder content is reduced, the contractions are weak and frequent, and the residual urine is high. Complete transection of the cauda equina produces complete bladder atonia. Tidal drainage is useless in these cases as automatic function will never develop.

Under the title of vesicourethral dystonias, the authors describe numerous and frequent obstacles which disturb the recovery of micturition. The most common are changes in the muscle fibers which result from distention, infection, and spasticity. The loss of tone, the sclerosis and the hypertrophy of the muscle fibers are the frequent causes of difficulty in urination, pollakiuria with active incontinence and passive incontinence. In difficult urination there is often residual urine caused by increased resistance at the bladder neck. Various remedies have been suggested such as plastic muscle transposition, presacral neurectomy, section of the hypogastric nerves, and sacral sympathectomies but the simplest and most efficacious procedure is the transurethral bladder neck resection. Pollakiuria with active incontinence is produced by spasticity and hypertrophy of the detrusor muscle. The bladder content is small and there is residual urine. A small amount of urine added to the residue produces micturition and results in continuous incontinence. Section of some of the parasympathetic fibers (nervi erigentes) or anterior rhizotomy of the first and second sacral roots is the most logical method of treatment. The administration of acopolamine, vitamin B<sub>1</sub>, and a high protein diet has also been recommended. Oftentimes good results can be obtained by transurethral neck resection followed by tidal drainage. In passive incontinence the bladder is distended and empties by over

flowing. If residual urine is present, bladder neck resection may help. However in these cases renal function is easily disturbed and no method of treatment is satisfactory. Cystotomy must be performed if signs of kidney damage are present.

The most frequent urinary complications in paraplegics are cystitis and ascending and hematogenous pyelonephritis. They are often associated with bladder stones and are more frequent in bedridden patients. The G and M solutions may dissolve or reduce the volume of the calcium carbonate and calcium phosphate calculi. However the larger calculi must be removed surgically. Streptomycin may help when penicillin or the sulfonamides do not succeed but it rarely stops an infection if a bladder stone or a suprapubic fistula is present. The prognosis of urinary infections in paraplegics remains poor.

GEORGE PERRET, M.D.

### PERIPHERAL NERVES

**Tensile Strength of Human Nerves. An Experimental Physical and Histologic Study.** C. T. LEE, C. E. BENDA, AND F. H. LEWIS. *Arch. New Psychol.*, Chic., 1948, 59, 312.

These authors have performed a very useful function in publishing the results of their obviously carefully made experiments on the tensile strength of human nerves. Their material consists of 22 human nerves—3 sciatic, 4 ulnar, 7 tibial and 8 peroneal—which were removed from cadavers 6 to 12 hours after death when death was in no way related to any condition of the nerves.

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**Post Traumatic Ossification of the Peripheral Nerves. Histogenetic Study of Heterotopic Osseous Neoformations (Ossificazioni posttraumatiche del nervi periferici. Studio sull'origine delle neoformazioni ossee eterotopiche).** LEONARDO GUT. *Chir. org. motum.*, 1948, 32, 241.

The author presents 7 cases in which calcification developed in and about the cicatricial regions of an injured nerve. Microscopic studies were made of the removed osseous neoformations. Three of these patients had suffered injury to the sciatic nerve (1 with and 2 without associated fracture), 1 patient had an injury of the median nerve, 2 patients had suffered injury to the radial nerves without associated fracture, and 1 patient had suffered an injury to the axillary nerve with associated fracture of the clavicle. The osseous processes were of no special significance as the nerve tissues themselves did not take part in the abnormal process of calcification and the newly formed bone was easily removed without any effect on the ultimate outcome of the case.

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JOHN W. BREXMAN, M.D.

## MISCELLANEOUS

Neurogenic Bladder (Vejiga neurogenica). Hicron  
VALLADARES A. *Arch. Soc. cir. hisp.* Santiago, 1947  
17: 383

The author reviews the anatomy and innervation of the urinary bladder and emphasizes the necessity of using cystometry for the correct diagnosis of functional disorders of the organ.

In the hypertonic bladder the sensitive cystometric points are displaced to the left, with a rapid increase of the manometric pressure. The so-called efferent neurogenic bladder of Simons is characterized by a small hypertonic bladder with great predominance of the parasympathetic function. It is encountered particularly in pyramidal lesions, multiple sclerosis, medullary tumors, and partial medullary involvements. The hypotonic bladder is characterized by displacement of the sensitive points to the right and by an organ of great capacity which is called afferent neurogenic bladder. Its mechanism seems to be determined especially by a considerable decrease in sensitivity which causes atony and atrophy of the detrusor muscle. This bladder has a very low pressure and empties poorly leaving a large residue. It is found in *tuberculosis dorsalis* and in lesions of the cauda equina.

Every urologist has seen patients with traumatic lesions of the brain, cerebral tumors, hemorrhages or inflammatory processes who, while conscious had involuntary micturitions. These patients have vesical retention during the period of shock, later they develop urinary symptoms connected with loss or decrease of function, they are incapable of starting micturition voluntarily or of controlling it.

In incomplete high medullary lesions the neurologic symptoms vary with the extent of the damage there may be delay in starting urination which then occurs with little force and a weak stream. In complete high lesions, as in traumatic cases or in myelitis, there is immediate retention, which may last for hours or days, followed by incontinence due to overflow and finally the establishment of a certain degree of urinary automatism. If the case becomes complicated by cystitis or any other kind

of acute infection the automatic mechanism is profoundly altered and the bladder becomes small, hypertonic, and with little capacity. Therefore, the treatment of vesical function must be in the hands of the specialist from the beginning.

In traumatic lesions of the lumbar and sacral segments the same stages are observed: retention, incontinence from overflow and automatism. But the latter is hard to attain especially in lesions of the sacral regions in which so-called paralytic incontinence is the rule. It is obvious that if the reflex center itself is involved the degree of automatism obtained will depend on the degree of damage sustained. Therefore, in these cases aseptic measures are imperative to preserve a good bladder function from the beginning.

In lesions of the cauda equina, and especially those in which the nerves corresponding to sacral nerves 3 and 4 are destroyed, extremely grave changes are produced because the principal routes of the vesical automatism are interrupted. Theoretically such a lesion should never improve but here occurs the best defense against traumatism because the displacement of the roots prevents their total destruction.

The lesions produced in *tuberculosis dorsalis* consist basically of an interruption of the sensorial reflex arc in such a form that the muscular tonus has disappeared with the production of an exaggerated stretching of the bladder wall; this results in an organ of large capacity with very low tonus and contraction that always leaves a large residue; the urinary stream is thin with final dribbling which may continue for some time.

In bilateral chordotomy incontinence is frequent, but not as frequent as has been reported. In unilateral chordotomy when a urinary complication occurs, it is a retention of short duration and the bladder function returns in a few days.

In hernias of the intervertebral disc in which it is necessary to displace the nerve roots beyond the midline, periods of postoperative retention are observed which may persist for some days but recovery of function is complete and practically normal.

RICHARD KENDER, M.D.

# SURGERY OF THE THORAX

## CHEST WALL AND BREAST

Advanced Mammary Cancer MAX CUTLER and  
MELVIN SCHLEMMERSON *J. Am. M. Ass.* 1948 133  
187

Twenty consecutive patients with advanced mammary cancer were treated with testosterone propionate intramuscularly. Initial doses of 300 mgm. were followed by 150 mgm. twice weekly until between 2,250 and 4,650 mgm. were given to the 5 patients whose cases are reported in detail.

Four of the 20 patients showed definite improvement in their condition. In 1 patient there was skeletal metastasis. In another skeletal and soft tissue metastasis. In 2 patients soft tissue metastasis. Recurrence developed in all of them within a year. The longest period of improvement was 11 months. Four patients all with the disease confined to the soft tissues showed transitory improvement in their condition with temporary tumor regression and improvement in their well being. Twelve patients showed no significant improvement. 6 of these had only soft tissue involvement and 6 only skeletal involvement initially although 3 developed skeletal metastases while under treatment. There was no evidence that the disease was accelerated by the treatment in any of these 12 cases.

On the experience with these 20 cases it seems advisable to withhold testosterone therapy until other well established procedures have reached the limits of their usefulness. Both surgical castration and roentgen sterilization frequently produce results which are comparable to those seen following testosterone therapy. Because testosterone increases the retention of sodium, potassium and protein nitrogen and hence water, testosterone should be used cautiously in patients with cardiac disease. It is suggested that treatment, when favorable, be continued until the palliative effect is no longer evident because in the present cases when treatment was stopped a second course of testosterone did not renew the initial favorable effect.

Masculinization and cessation of the menses occur when more than about 200 mgm. of testosterone are administered per month. There is no evidence that cure can be achieved by testosterone therapy and palliative results can be anticipated in only a relatively small number of patients.

FRANK B. QUINN, M.D.

## TRACHEA, LUNGS, AND PLEURA

Exploratory Thoracotomy in the Management of Intrathoracic Disease. JOHN B. GROW, MARTIN L. BRADFORD and HUGH W. MAHON *J. Thorac. Surg.*, 1948 17 480.

The present day use of mass x-ray surveys of the chest and the taking of chest roentgenograms rou-

tinely on hospital admissions in many institutions has disclosed an increased number of asymptomatic thoracic lesions. Consecutive hospital admission roentgenograms are estimated to present evidence of thoracic disease in from 8 to 10 per cent of cases.

Such cases tax the clinician's diagnostic ability severely because all too frequently a conclusive diagnosis cannot be made even after the most complete and exhaustive study. As a final diagnostic approach in such cases exploration is recommended.

The authors report on an experience with 500 consecutive exploratory thoracotomies performed at Fitzsimmons General Hospital, Denver, Colorado between September 1944 and April 1947.

The lesions were distributed in the following locations: the mediastinum 73, the lung, 113, outside of the lung (exclusive of mediastinal and vascular) 8 and in the heart and great vessels 6.

In these cases there was an overall incidence of malignant lesions of 21.5 per cent. The roentgen appearance of the pulmonary conditions was that of circumscribed lesions in 86 cases and of atelectasis in 35 cases. The circumscribed lesion was proved to be malignant in 21 cases and tuberculous in 37. The atelectasis resulted from bronchogenic carcinoma 11 times and from tuberculous 3 times. Sixteen per cent of the mediastinal lesions were proved to be malignant.

The various possible diagnostic procedures are given brief appraisal. It being pointed out that positive bronchoscopic biopsy can be expected in only about 50 per cent of the resectable neoplasms. Likewise the practice of relying on a test dose of x-radiation as a means of identifying members of the lymphoblastoma group of tumors is condemned because

1. All malignant lymphomas do not respond to x-ray therapy.

2. Many benign lymphadenopathies and resectable malignant lesions of the thymus do respond to irradiation and this would lead to an erroneous diagnosis.

3. There are indications that the prognosis of localized mediastinal lymphoma is improved by combined resection and irradiation therapy.

4. The prompt establishment of a histologic diagnosis expedites the initiation of treatment.

Since the incidence of malignancy is significantly high in the obscure intrathoracic lesions described and the treatment of choice in the vast majority of nonmalignant conditions is surgical removal anyway, exploratory thoracotomy is recommended after the more conservative diagnostic methods which are employed expeditiously have failed to clarify the condition.

The risk of exploratory thoracotomy per se is nil, the mortality being dependent upon the gravity of the therapeutic portion of the operation. There

were 8 deaths in the series 5 following pneumonectomy for cancer and 1 death following pneumonectomy for blastomycotic suppurative disease; 1 death followed a lobectomy and the last death occurred in a patient with an inoperable neurogenic sarcoma. The morbidity was as follows: 12 pleural effusions 5 postoperative atelectasis 3 minor wound infections and 4 empyemas.

The text is supplemented by 19 illustrative roentgenograms 3 statistical tables and 37 bibliographical references  
 HIRSH T. LANGSTON, M.D.

**Transstracheal Anesthesia for Bronchoscopy** DWIGHT E. HARKEN and ARNOLD M. SALASERO. *N. England J. M.* 948, 290-293.

Since bronchoscopy contributes greatly to the diagnosis and treatment of intrathoracic disease the use of a proper anesthetic during the operation serves the interest of both the patient and the bronchoscopist.

A method of administering a dilute pontocaine solution for bronchoscopic anesthesia via the cricothyroid membrane directly into the trachea is described. The technical details of the procedure are outlined.

The safety of the method is supported by experience in more than 1,000 patients. Only 3 of the patients developed a superficial cellulitis of the soft tissues about the site of the injection. This method of anesthesia should not be used in the presence of extensive tuberculous disease of the larynx and upper trachea since there may be danger of the development of a tuberculous sinus in such cases. No sinuses, however, resulted among the 1,000 cases described, though the anesthesia has been extensively used in open cases of tuberculosis.

The application of this form of anesthesia in bronchoscopy for the removal of foreign bodies is contingent upon the position of the foreign body itself.

SAMUEL KARO, M.D.

**Chronic Nonspecific Suppurative Pneumonitis.** RICHARD D. KEEFER and W. E. ADAMS. *J. Thorac. Surg.* 948, 7-9.

This article describes the clinical picture of a pulmonary condition which is insufficiently well defined to be considered a disease entity. The report is based on an experience with 10 cases of suppurative pneumonitis.

The disease is characterized by an insidious onset, chronic course, productive cough and hemoptysis and a diffuse chronic inflammation of the lung without abscess formation.

The clinical characteristics include chest pain with low-grade fever as well as cough and hemoptysis. The symptoms have lasted from 6 months to as long as 22 years. Females predominate 8 to 1 among the patients so afflicted and the 30 to 50 age group is chiefly affected.

The condition must be differentiated from bronchogenic carcinoma, chronic lung abscess, tuberculous, and bronchiectasis. The principal features

of the differential diagnosis are the gradual onset of symptoms without obvious cause and diffuse infiltration of the lung without signs of bronchial dilatation or cavity formation on x-ray examination. Differentiation from bronchogenic carcinoma in the cases of short duration usually must await pathologic study. No definite etiologic agent has been found. The bacteriologic flora is nonspecific. Tubercle bacilli are of course absent.

The basal portions of the lung were involved more frequently than the upper, the right side more often than the left, although 1 case was bilateral. The pathologic picture includes interstitial fibrosis, thickening and fibrosis of the alveolar walls, lymphoid hyperplasia, narrowing of the bronchial lumen by redundant mucosa, chronic atelectasis, and infiltration by macrophages.

The treatment recommended is resection. Under medical management many of the patients showed transient improvement, but the symptoms recurred and progression of the lesion could be demonstrated with x-rays. Most of the patients became significantly incapacitated.

Surgery with drainage or resection was employed in 9 patients. In 1 case only was a biopsy taken (bilateral involvement). The 9 patients all returned to full activity in 1 to 3 years except 1 who died of pneumonia 5 days after operation. Resection is preferred because the period of morbidity is shorter than with drainage (with resection the hospital stay averaged 33 days as against 50 days with drainage and clearing of the lung fields occurred in from 6 to 7 months as against 18 months) and the relief of symptoms is likely to be more complete. Also when bronchogenic carcinoma cannot be ruled out, an added reason for resection is present.

The text is supplemented by illustrative roentgenograms and photographs. Statistical data is presented in tabular form. Two detailed case histories are appended.

HIRSH T. LANGSTON, M.D.

**Pulmonary Decortication in the Treatment of Early Pyogenic Empyema.** EDWARD F. PARKER and THOMAS H. DUFFORD. *Surgery* 3043, 2413-2418.

The authors have revived the idea of early post-empyema mobilization of the lung. They state that in order for decortication to be successful three conditions must prevail and for the most part they are present before the empyema is "chronic": (1) there must be a line of cleavage between the inflammatory membrane and the capsule, (2) the underlying viscera must be normal rather than thickened and fibrotic (this tends to be the case early in the course of the empyema) and (3) the lung must be intact and able to expand completely, not atelectatic.

Indications for primary decortication without preliminary drainage are (1) the presence of a massive cavity causing 50 per cent or more collapse of the lung and more particularly if collapse involves the apex of the lung; and (2) fever of no more than from 102.0 to 103.0 degrees as this does not

contraindicate primary operation if the patient does not appear too toxic. The time for primary decortication from a pathologic standpoint is within 6 weeks of the onset of empyema and preferably as soon as the diagnosis is made and the patient is prepared.

Secondary decortication is indicated for the same reasons as already stated and is done in early empyema—that is, 4 weeks after adequate rib resection drainage. If the lung fails to expand further and the empyema cavity does not diminish a secondary decortication is done. Needless to say, if there is present a lung abscess or a bronchopleural fistula it must be eradicated at or before the time of decortication.

The two important factors in successful postoperative management are (1) complete pulmonary expansion maintained by drainage and (2) parental and local antibiotic therapy for from 7 to 14 days postoperatively.

Two cases of primary decortication done 33 and 41 days after onset of empyema, respectively are reported. Three cases of secondary decortication done 31, 28 and 33 days respectively after rib resection are presented.

JANE C. MACMILLAN M.D.

**Stasis in Lung Abscess. The Etiology of Lung Abscess.** R. C. BAOCZ. *Guy's Hosp Rep* Lond 1948, 96: 141.

When sufficient care is taken in elucidating the history of lung abscess a primary or existing cause can be found in about 75 per cent of the cases. Only after all avenues of approach are exhausted should the diagnosis of primary lung abscess be accepted.

Many analyses of the etiology of lung abscess have been made in the literature. Among the causes listed are operations on the upper respiratory tract, such as tonsillectomy, tooth extraction and sinus operations; other operations under general anesthesia; pneumonia; influenza; malignant disease; bronchiectasis; acute respiratory infections; dental sepsis; and such causes as epilepsy, alcoholic stupor and submerision. The percentages of these causes have varied greatly from one series to another. It is also of interest that in some large series no mention is made of malignant disease and it is quite striking that dental sepsis as a cause is omitted in most series.

In a series of 363 cases of lung abscess composed of one group of 176 consecutive cases seen from 1943 through 1946 and a second group of 87 operative cases the basic etiology is analyzed. Forty-seven cases (13%) were due to bronchial carcinoma. Other nonmalignant causes which were identified involved 123 cases (61.5%) making a total of 170 (74.5%) in which the causes were identified. Thus only in 93 cases (25.5%) was the cause obscure and the diagnosis of "primary lung abscess" made. Of the 316 nonmalignant cases 80 (25.5%) were found to be postoperative, 41 occurring after abdominal operations and 39 after nonabdominal operations. Of the latter 25 occurred after tooth extraction and 7 after tonsil-

lectomy. Sixty cases (19%) were classed as being due to dental sepsis. Specific infections with the Staphylococcus, Streptococcus, Friedlander's bacillus, and the Actinomyces accounted for 16 cases (8%). Fifty-six (18%) resulted from various identified causes making a total of 212 cases (70%) in which the causes were identified. Ninety-four cases (30%) were classed as obscure primary or cryptic lung abscesses.

The various factors responsible for the high incidence of lung abscess following tooth extraction appear to be multiple extractions under deep anesthesia, extraction of septic teeth with tartar masses, upright position in the dental chair and badly given nitrous oxide anesthesia with cyanosis and obstructed respiration. The position of the patient during recovery from anesthesia for operation on the mouth, nose and pharynx is an important consideration; the prone position provides the greatest freedom from the risk of bronchial embolism, as fewer bronchi are vulnerable in this position. Raising the patient's feet lessens the risk even more.

Gross dental sepsis is a very important factor in the etiology of lung abscess and elective surgery should not be embarked upon in the presence of pus pockets, gum infections, and tartar masses. Anesthetists and surgeons alike share the responsibility for proper preoperative dental care in all but emergency cases.

In patients below the age of 15 the cause of lung abscess is almost always identified; the most common cause being staphylococcal pneumonitis. Contrary to the usual belief, abscess secondary to an inhaled foreign body is quite rare; only 3 cases being encountered in the entire series.

In young adults from 15 to 25 years of age the cause is usually apparent. An operation is the most likely preceding event, tooth extraction and tonsillectomy being of equal importance.

In older patients the proportion of cases in which the cause cannot be identified or is found only after searching inquiry increases. Preceding operation including tooth extraction and gross dental sepsis are leading causes. Carcinoma must be considered in this group. In obscure cases such items as the patient's occupation, alcoholic intoxication, epilepsy, immersion and overdose of sedatives must be thought of and asked about specifically. Tuberculosis always demands exclusion, especially in obscure middle lobe abscesses. With increased knowledge, experience and diligence the percentage of "obscure" or primary lung abscesses should continue to decrease.

JESSE E. THOMPSON M.D.

**Nonmalignant Intrathoracic Lesions Simulating Bronchogenic Carcinoma.** LYMAN A. BREWER, III, WILFRED M. G. JONES, and FRANK S. DOLLEY. *J Thorac Surg*, 1948, 17: 439.

In the authors' experiences with 300 cases of lung carcinoma, only about one-half could be visualized by bronchoscopy. The authors have classed those lesions of the lung beyond the limits of bronchoscopic

diagnosis as peripheral, and in this presentation they review 30 nonmalignant intrathoracic conditions which simulated bronchogenic carcinoma and which were subjected to surgery. The 30 were as follows:

Inflammatory	20
Lung abscess	6
Tuberculosis	5
Pneumonitis	3
Bronchiectasis	3
Granuloma	
Echinococcus	
Silicosis	
Benign tumors	6
Adenoma	3
Lipoma	
Fibroma	
Developmental	4
Cysts	3
Thyroid	

Of these 30 benign instances 23 could not be expected to end in recovery with conservative treatment, 6 cases were equivocal, and 1 case was hopeless regardless of the type of treatment employed. Twenty-seven patients were cured by surgery, 2 were not benefited, and 1 patient died after operation.

The authors emphasize the difficulty in establishing the preoperative diagnosis of bronchogenic carcinoma in locations where visualization and biopsy by bronchoscopy is not possible and conclude with a recommendation for exploratory thoracotomy when carcinoma cannot definitely be eliminated. If carcinoma is found, pneumonectomy is the procedure of choice. If a benign lesion is present, this series indicates that in most instances simple local resection is necessary.

The authors liken the management of suspected bronchogenic carcinoma to that of suspected mammary carcinoma, in which exploration and biopsy are done followed by radical excision if cancer is found.

C. FREDERICK KITTELL, M.D.

**The Diagnosis and Operability of Bronchogenic Carcinoma.** JOHN H. GIBSON, JR., LOUIS H. CLEGG, PETER A. HENRY, and JOHN J. DETURKLE.  
*J. Thorac. Surg.* 1943, 17, 49.

Carcinoma of the lung ranked fourth as the cause of death among cancer mortalities in 1944. Because of this, the need for its earlier diagnosis, more radical operation, and the reduction of postoperative mortality are stressed by the authors in consideration of 56 consecutive cases of bronchogenic carcinoma seen at Jefferson Hospital, Philadelphia.

Education of the public and the general practitioner in the recognition of premonitory symptoms will help most. The first symptoms in this series in order of decreasing frequency were cough, production of sputum, chest pain, hemoptysis, weight loss, dyspnea, wheezing respiration and bouts of pocu-

monitis. A diagnosis of virus pneumonia or unresolved pneumonia in males between the ages of 40 and 70 years should not be made without excluding the possibility of a carcinoma, which occludes the bronchus with infection distal to the point of obstruction. Roentgenoscopic examinations in patients with bronchogenic carcinoma almost always reveal some abnormality. Bronchoscopy will often confirm the diagnosis suggested by the x-rays, provide a positive biopsy or in rare instances disclose a tumor not apparent on roentgenological examination. Needle biopsy may be done in those instances in which the tumor is peripherally located, but this method is not particularly recommended. An important adjunct to the diagnosis of bronchogenic carcinoma is the cytologic study of bronchoscopic aspirations. If no secretion is obtainable from the bronchus, from 3 to 5 c.c. of salt solution may be injected into the bronchus and then removed. Of 118 cases studied by this method by the authors 90 per cent showed neoplastic cells, while in the same group only 45 per cent provided a positive bronchoscopic biopsy. In some patients a definitive diagnosis can not be made without exploratory thoracotomy.

All patients should be subjected to thoracotomy unless there is unequivocal evidence of extension of the disease beyond the hemithorax in which the tumor lies or unless a pleural effusion exists which is bloody or contains malignant cells. In the group with nerve palsies indicating involvement of the phrenic nerve, recurrent laryngeal nerve, or sympathetic trunk, the issue is debatable, some tumors being resectable by block dissection and others being inoperable.

The decision as to whether or not a pneumonectomy should be done is based on the same principles as are applied to cancer surgery for tumors located elsewhere in the body. If all visible and palpable tumor can be removed without leaving any evidence of malignant tissue the authors believe a radical pneumonectomy should be done. The procedure suggested by Allison is believed most effective; this consists of intrapericardial ligation of the pulmonary vessels at their junction with the left auricle.

In 20 pneumonectomies and one partial removal of the right lower lobe by the authors there were 3 deaths: one due to tension pneumothorax, the other from an empyema secondary to bronchopleural fistula. This represents a considerable decline in postoperative mortality from previous years.

C. FREDERICK KITTELL, M.D.

**The Treatment of Inoperable Bronchogenic Carcinoma with Methyl-Bis.** EDWARD F. SEIDNER, DUANE CARR, and WILLIAM E. DEEMAN. *J. Thorac. Surg.* 1943, 17, 428.

The authors report their experiences in the treatment of 25 patients with inoperable bronchogenic carcinoma by means of methyl bis (beta-chloro-ethyl amine hydrochloride), a derivative of the nitrogen mustard compounds best known for its palliative action in lymphomas. Methyl-bis has been shown to

produce its effects by direct action on the chromosomes.

Their procedure consisted of the intravenous administration of 0.1 mgm. of methyl bis per kilogram once daily for 4 days usually with 1,000 c.c. of isotonic saline solution. This was repeated in 2 or 3 months and more often when desired the patient usually being hospitalized for 5 days during the administration of methyl bis. The history, physical status, blood count and fluoroscopic or x-ray findings were ascertained every 2 weeks.

About 50 per cent of the patients develop varying degrees of nausea, vomiting and anorexia after administration of this chemical but these conditions are usually of shorter duration than when they are caused by x-ray treatment. This incidence can be reduced by giving 100 mgm. of pyridoxine hydrochloride early in the morning of the treatment day. From 10 to 20 per cent of the patients may require blood transfusions to combat the erythrotoxic effect of methyl bis.

Methyl-bis is more advantageous than x-ray therapy because it is cheaper, is more easily administered, may be used in cases with widespread metastases in which irradiation is of little value and because the toxic symptoms are less severe.

Twenty-five patients with far advanced bronchogenic carcinoma were treated with methyl-bis. Of these 3 had adenocarcinoma, 5 had squamous-cell carcinoma and 17 had undifferentiated cell carcinoma. The clinical course of 17 is reported in detail and of these 10 received irradiation in combination with the methyl bis. The majority of the patients showed improvement in their condition as manifested by weight gain, decrease in cough, dyspnea and bouts of pulmonary infection and by the alleviation of pain.

This chemical is suggested as a palliative agent in the treatment of inoperable bronchogenic carcinoma.

C. FREDERICK KITTLE, M.D.

## ESOPHAGUS AND MEDIASTINUM

The Importance, and a Discussion of Connectivomas of the Upper Respiratory Tract (Relievi e considerazioni sopra i connettivomi delle alte vie aeree) CARLO SIRTORI and CESARE BECCHERLE. *Tumori Milano* 1948 34: 12.

During a period of 20 years the authors treated 175 patients with connective tissue tumors of the upper respiratory tract. There were 77 reticulosarcomas, 37 angiosarcomas and fibrosarcomas, 31 sarcomas, 7 lymphosarcomas, 6 epulis, 5 osteomas, 4 endotheliomas, 3 fibromas, 2 chondromas, 2 plasmocytomas, and 1 lymphoepithelioma.

Reticular cells even if they become malignant, preserve their evolutionary omnipotence. According

to the predominating tendency sarcomatous histiocytic, and endothelial varieties of reticulosarcomas may be distinguished. Occasionally an evolution of the same group of tumors toward fibrosarcomas or lymphosarcomas may be observed. Aplastic forms or reticulosarcomas in the strict sense of the word must be distinguished from blastic forms such as histiocytic fibrocystic, endothelial or lymphocytic types. A precise diagnosis is of importance for the prognosis: pure reticulosarcomas and the lymphosarcomatous forms are more malignant but also more radiosensitive than other types.

Polyps may assume the form of a circumscribed elephantiasis with all the evolutionary possibilities of such formations.

Typical and atypical forms of blastic sarcomas may be distinguished: Myxoblastic, fibroblastic, lipoblastic, angiofibroblastic, chondroblastic, and osteoblastic tumors belong to this group. The anaplastic sarcomas may also be divided into typical and atypical types. Such classification is of clinical importance. Typical blastic sarcomas are relatively benign. They rarely recur and infiltrate adjoining tissues but they rarely produce distant metastases. Atypical blastic tumors show a greater aggressive infiltrating activity and form distant metastases. Atypical anaplastic sarcomas possess the highest degree of malignancy.

JOSEPH K. NARAT, M.D.

## MISCELLANEOUS

Radical Extirpation and Primary Closure of Deep Thoracic Fistulas. JENY L. HANSEN. *Acta chirurgica*, 1948 96: 485.

A method for the operative treatment of deep thoracic fistulas with chronic empyema or abscess of the lung is described. A regular large thoracotomy is made and all pathological tissue is removed. The extirpation extends from the skin fistula to the inner side of the thoracic wall and on or in the lung where the bronchial fistulas are sutured. The wound cavity is powdered with penicillin and sulfathiazole. Primary suture is done in layers with silk. The wound exudate is aspirated daily and systemic treatment with penicillin and sulfathiazole is administered.

Five case reports are presented. In 1 patient a drain had to be used on account of persistent infection. In this case the organisms were resistant to penicillin and sulfathiazole. In all other cases primary healing was achieved. In less than a month all of the patients were cured of an illness lasting from 6 to 12 months.

The operation causes no deformity of the skeleton, gives the best possible lung function and requires only simple postoperative treatment.

JOHN J. MALONEY, M.D.



# SURGERY OF THE ABDOMEN

## ABDOMINAL WALL AND PERITONEUM

**The Hernia Problem, with Reference to a Modification of the McVay Technique.** JACK M. FARLEY, JEROME EITZINGER, and JOSEPH A. WEINBERG. *Surg* 1945, 24, 793.

The authors contend that indirect hernias, particularly in young people are best dealt with by simple excision and transposition of the hernial sac with minimal disturbance to either the cord or the floor of the inguinal canal. Suturing the conjoined tendon to Poupart's ligament is fallacious because (1) there is no weakness in the floor of the canal, (2) nowhere in human anatomy is muscle used as a buffer state and (3) muscle fixation is bound to result in atrophy from disuse. About 75 per cent of recurrences do not occur through the posterior wall but through the internal ring; therefore operations designed to reinforce the floor of the canal are ill conceived.

Simple ligation of the sac is inadequate if the internal ring is dilated or if there is weakness of the posterior wall of the inguinal canal. When the latter exists the problem is the same as in direct hernia.

The authors summarize the anatomical studies of McVay and Anson which note that the transversalis fascia, transversus abdominis and internal oblique muscles do not insert on the inguinal ligament, and that suturing of these structures to the inguinal ligament violates the surgical principles of restoring musculofascial anatomy to normal.

Cooper's ligament hemiorrhaphy is the operation of choice in dealing with large indirect hernias (with associated defect of the inguinal floor) direct hernias, recurrent hernias and femoral hernias. The authors describe the surgical technique employed and supplement the article with four excellent illustrations.

ELY ELLIOTT LAZARUS, M.D.

**The Relation of Incisional and Inguinal Hernias, as Well as of Mechanical Intestinal Disturbances, to Previous Operations for Appendicitis with Peritonitis.** ALVIN FINKELSON. *Acta chir scand* 1945, 96 Suppl. 35.

The author presents a survey of clinical material on the subject of incisional and inguinal hernias studied from many different points of view as well as his personal observations on many aspects of the subject. Considerable space is given to an historical account of the development of therapy in these cases. The clinical material was obtained from three different hospitals.

The author was unable to establish any relationship between age and the occurrence of inguinal hernia; however he noted that incisional hernias occurred more frequently in women than in men. He also noted that incisional hernias occurred somewhat more frequently in intellectual workers than in laborers. He noted an increased predisposition to

incisional hernia in cases in which the time between the onset of the disease and operation was prolonged. The incidence of incisional hernias increased as the stage of the disease advanced which finding is compared with appendicitis with perforation and appendicitis without complications. A prolonged period of drainage also predisposes to incisional hernia.

The author observed that inguinal hernia occurred more frequently following use of the McBurney incision than with Lennander's and Krogh's incisions. Total intestinal occlusion occurred more frequently after operations for conditions in the "abdominal stage" than in conditions operated upon earlier.

ROBERT E. FLOWER, M.D.

## GASTROINTESTINAL TRACT

**Diagnostic and Therapeutic Problems in Diverticulitis.** C. P. LILLY, JR., and BENJAMIN V. WHITE. *England J M* 1945, 30, 243.

During the 50 year period from 1937 to 1946, 300 cases of diverticulitis were seen at the Hartford Hospital, Hartford, Connecticut, which serve as the basis for this study. Of these 50 were complicated by perforation or obstruction. This incidence as noted by the authors, is much higher than in the community at large as many patients are selected for hospital admission because of symptoms attributable to the complications rather than to the disease itself.

Diverticulosis and diverticulitis are relatively common in persons past the age of 45 years. Diverticulosis occurs at some time in from 17 to 27 per cent of all cases of diverticulosis. The authors of this article emphasize the difficulties of diagnosis that arise from confusion with diseases affecting neighboring organs rather than the incidence statistics, and pathological features of the disease.

In the 300 cases of diverticulitis reported, the diagnosis was made by means of the clinical picture in addition to the x ray findings in 161 cases, at operation in 32 cases, by the clinical picture alone in 5 cases, and at autopsy in 3 cases. Of the 32 patients in whom the diagnosis was made at operation, 15 were suspected primarily of having acute appendicitis, and 17 were operated upon with such pre-operative diagnoses as pelvic inflammatory disease, acute cholecystitis, intestinal obstruction, and ruptured ovarian cyst. However in none of these 32 cases was a barium enema given.

The leading signs and symptoms were similar to those described by others and consisted of abdominal pain, fever, constipation, leucocytosis, diarrhea, back pain, and melena.

The authors noted pain in the lower back in 50.5 per cent of their cases. Heretofore little emphasis had been placed on this symptom, but in their experience this symptom may be a striking part of the

clinical picture. Another symptom often the presenting complaint, was the passage of blood by rectum. This may appear as free blood or as flecks on the fecal material. Melena occurred in 16.5 per cent of the cases reported in this series. This sign is somewhat disconcerting, because it detracts from the significance of blood in the rectosigmoid as an indication of polyps or other neoplastic lesions and complicates the differential diagnosis.

Of the 200 Hartford Hospital patients 161 had barium enemas that showed diverticulosis in the colon and 133 of these demonstrated definite spasm of the sigmoid with narrowing of the lumen. A mass was demonstrated by barium enema in 33 of the 161 and the mass was invariably in the sigmoid region. However the appearance of a mass on x ray examination is not necessarily diagnostic, since it may indicate an unrelated carcinoma or other disease.

Complications were encountered in 50 cases or 25 per cent of the series. There were 45 cases of perforation and 7 cases of mechanical obstruction due to local inflammation. Of the cases of perforation, 32 led to local abscesses 1 to generalized peritonitis 4 to mechanical ileus and 6 to fistulas.

Sixty three operations were carried out, 19 for diagnostic purposes. In all of the patients there was acute diverticulitis of the sigmoid. Six patients were operated on for other conditions and acute diverticulitis was found incidentally. There were 38 therapeutic surgical procedures which included irrigation and drainage of abscesses, colostomy, cecostomy, Mikulicz procedures and resections.

EDWARD F. LEWISON, M.D.

#### Diverticula of the Stomach. Report of 26 New Cases.

S. P. BRATLOW and M. A. SPELLBERG. *Gastroenterology* 1948, 11, 59.

The authors discuss the available literature and report 26 new cases of apparently true and 4 cases of false or acquired gastric diverticula. This number represents about 0.015 per cent of all admissions but 2.6 per cent of 350 gastroscopies showed gastric diverticula. Apparently the incidence of this lesion is not as rare as is generally believed.

Radiologically their series showed 17 true diverticula located on the posterior wall of the lesser curvature of the cardia while 7 were found at the same location in the pars media. Two were observed on the greater curvature of the cardia. Of the false or acquired diverticula, 3 were found in the pyloric region on the lesser curvature and 1 was observed at the posterior wall of the greater curvature in the pars media. Two of the 3 pyloric diverticula were on the posterior wall and the third was on the anterior wall.

All 26 of the authors' patients had symptoms referable to the gastrointestinal tract at one time or another but 15 had associated lesions that probably contributed to the symptomatology. In general, however, the symptoms are neither diagnostic nor characteristic, but may be incapacitating with pain, vomiting and hemorrhage. It is probable that the

production of symptoms depends upon complications such as inflammation or ulceration of the diverticulum and that both of these may depend on retention of food particles in the sac. Occasionally a gastric diverticulum may cause typical ulcer pain which is relieved by food and alkalis.

The radiologic diagnosis depends on the retention of opaque media, and is most commonly seen after the stomach empties.

In the experience of Bratlow and Spellberg gastroscopy for visualization of diverticula affords no more risk than gastroscopy for other lesions. The gastroscopic appearance is quite characteristic and cannot be easily confused with other lesions. The ostium of the diverticulum may be perfectly round or oval and may change in size and shape during observation. In some cases one may observe a ridge or slight elevation suggestive of a ring of muscle fibers surrounding the opening in other instances rugal folds resembling those seen in a gastric ulcer are observed radiating toward the ostium. The depth of the opening is dark, while in an ulcer crater the base is covered by an exudate.

As a rule the diagnosis of gastric diverticula is not difficult provided the clinician is mindful of this lesion and institutes careful roentgenographic and gastroscopic studies. It should also be kept in mind that since gastric diverticula frequently may be asymptomatic, their mere presence should not be accepted as the sole factor accounting for the patient's symptoms. Before attempting therapy it is imperative to make certain that the diverticulum is inflamed, retentive and the sole cause of the existing symptoms. If the symptoms are mild a medical regimen of a bland smooth diet, and alkalis and bismuth taken 1 to 2 hours after meals will afford relief. Gastric lavage and postural drainage may be helpful when retention in the diverticulum is present. Prolonged postural drainage is particularly advised for diverticula located at the cardia. However if the symptoms persist, or associated lesions such as benign or malignant ulcerations are suspected or found surgery is indicated. Total excision of the diverticulum with inversion of the stump should be attempted. Simple invagination of the pouch with a closure of the mural muscular ring by a purse string type of suture is not adequate.

During surgical exploration it is frequently difficult to find the diverticula. In 3 of the authors' 5 cases the diverticula could not be located at operation. To obtain the best exposure the gastroduodenal ligament and the gastroduodenal omentum may have to be divided. This maneuver will permit the mobilization of the fundal end downward and toward the midline. Occasionally the gastrophrenic omentum also must be divided.

ROBERT TURKLE, M.D.

#### Neurohumoral Aspects of Peptic Ulcer Formation

J. WEXNER and H. E. HERR. *Canad. J. Ass. J.* 1948, 59, 115.

In spite of the early and many brilliant observations of clinical pathologists pointing to the asso-

ciation of brain damage and changes in the stomach the concept of the neurogenic basis for ulcer formation was given little consideration because of the dominating views of Virchow who held that peptic ulcer was essentially a local disease. Interest in this aspect of ulcer formation was revived by Cushing's Balfour Lecture. The authors, in an exhaustive and thorough review of the clinical and experimental evidence of the neurohumoral aspects of ulcer discuss the etiologic factors of chronic peptic ulcer in man.

In surveying the clinicopathological literature for evidence of the association of gastric and duodenal lesions with intracranial disorders the authors found that nearly all of the lesions were of the acute type. There was no special preference for localization and the gastrointestinal lesions were usually multiple. Almost all ulcers were a hemorrhagic type of erosion with edema of the mucous membrane. Most of the cases of gastrointestinal bleeding or perforation were noted very shortly after brain injury. Intracranial damage in the neighborhood of the third and fourth ventricle was most frequent in the cases of trauma.

Reviewing the experimental evidence, the authors believe that it may not be justifiable to interpret the types of responses obtained from hypothalamic lesions as purely sympathetic or parasympathetic, for evidently both systems were frequently activated simultaneously. It seems more correct to consider that lesions placed in the hypothalamus upset the autonomic regulating mechanism, thereby setting up a state of autonomic imbalance resulting in vasomotor changes in the gut. These may be severe enough to cause mucosal hemorrhage or acute ulceration. Although there is clear-cut evidence that hypothalamic lesions and lesions of the pons, medulla, and upper spinal cord may initiate acute gastrointestinal lesions, there is no evidence that these lesions have ever gone on to form chronic ulcers of the type seen in man.

Studies on vagotomies and splanchnicectomies confirm the work done on damaging the hypothalamus in experimental animals. By creating an imbalance in the autonomic innervation of the gut, there resulted alterations in gastrointestinal motility, secretion, and vascular changes in the mucosa. Acute ulceration may occur but rarely if ever do these changes go on to chronic ulcer.

Reviewing the relation of gastric secretion to peptic ulcer the authors conclude that the main body of evidence indicates that the nocturnal gastric secretion in patients with ulcer is generally greater in volume and higher in acidity than that found in normal subjects. However a more careful study under rigidly controlled conditions would be necessary before any definite conclusions could be drawn. The range of acidity of the gastric contents of patients with ulcer closely parallels that found in normal subjects varying from complete acidity to hyperacidity. The experimental evidence reviewed by the authors fails to offer convincing proof that hyper

secretion of acid or excessive nocturnal gastric secretion are prime factors in ulcer pathogenesis. Acid peptic secretions only act upon mucosa which has already been injured.

The experimental and clinical evidence reviewed indicates that the absence or deficiency of intestinal secretions and mucus are not responsible for the production of ulcer per se yet the deficit of these neutralizing factors may be of some importance in ulcer formation. The work of Winkelslein, Fogelson, Dragstedt, and Wangensteen is carefully considered.

Although the authors point out that vagotomy has yielded immediate relief of ulcer symptoms and has allowed for prompt ulcer healing the postoperative period of observation has been short. Wolf and Andrus have shown that gastric hyperemia and engorgement of the stomach mucosa due to vascular congestion induced by feelings of anger and resentment in a patient with a gastrostomy fail to occur after vagotomy. Thus, any permanent benefits from vagotomy may be the result of interruption of the cephalic impulses.

The work of many investigators is critically reviewed regarding the administration of pilocarpine, adrenalin, atropine, mebolyl, histamine, ptyferin, and caffeine. The gastrointestinal lesions thus produced were all of the acute type.

Repeated vascular insults to the gastrointestinal mucosa produced by various experimental methods although severe enough, produced only transitory ulcers.

The authors in a review of more than 350 references conclude that there is a physiological basis for the neurogenic concept of ulcer formation. Marked circulatory disturbances initiate acute gastrointestinal lesions. The psychosomatic concept of ulcer formation is considered an important factor. Peptic ulcers may well be a pathological sequel to autonomic nervous imbalance created during sustained emotional strain or conflict.

EDWARD F. LEWIS, M.D.

**Synthetic Resin—A New Antacid for the Treatment of Peptic Ulcer.** MANFRED KRAMER and LEO H. BROOK. *Arch. Surg.* 1948, 56, 3, 8.

The discovery by Adams and Holmes, in 1935 that phenolic resins have ion exchange properties started a revolution in the chemical world. It now became possible to remove both acids and alkalis from solutions without changing the nature of the original solvent. Since these substances are nontoxic for human beings, it was inevitable that they would find a place in medicine.

The authors studied a synthetic resin, amberlite IR IV (metaphylene diamine) and believe that it approaches the ideal antacid in that it appears to be as effective as the usually employed salts of calcium, magnesium, and aluminum, but does not produce any of their untoward reactions. It is not absorbed from the digestive tract, has no effect on the acid-base balance and does not alkalinize the urine. It does not affect the bowels or irritate the gastric

mucosa. It neutralizes acid rapidly and promptly relieves pain. It is effective in small doses and is inexpensive and tasteless.

In the 60 cases studied it was used in doses ranging from 2 to 9 gm daily for from 6 to 8 months at a time with no evidence of toxicity as manifested by examination of the skin blood and urine. Considerable freedom from pain as evidence of the healing of an ulcer 47 of the patients have been benefited by resin therapy. Six patients did not respond well to resin or to any other antacid therapy and required subtotal gastric resection. Three patients did not respond to resin therapy but did well when given other antacids. Two patients were not relieved by resin or other antacids but were kept free of symptoms by nightly aspiration of the gastric contents. Two patients could not be followed up adequately.

JOHN J. CRANLEY JR., M.D.

**Penicillin in the Postoperative Treatment of Peptic Ulcer with Perforation, and Appendicitis with Perforation.** ROBERT B. BROWN AND DON L. ANDRUS. *Ann. Surg.*, 1948 128 57.

The present report is based on a study of 48 cases of perforated peptic ulcers and 97 cases of perforated appendices. These patients were operated upon at the Philadelphia Naval Hospital during the 18 month period between January 1, 1946 and June 30, 1947. Since the vast majority of these cases were surgical emergencies operation was performed by the surgical watch officer. All patients received penicillin postoperatively but in 34 of the 48 cases of perforated peptic ulcer the initial dosage was 100,000 units every 2 hours. Dosage was continued at this level for varying lengths of time—up to 18 days in one patient. The average duration at this level of dosage was 8.5 days. Penicillin was then tapered off through decreasing dosage before being discontinued. Four patients received an initial dosage of 50,000 units of penicillin every 3 hours and the remaining 4 received a still smaller dosage. There were two deaths in this group before the 100,000 units every 2 hours was established as a routine. The usual postoperative regime of support with intravenous fluids and Wangersteen suction was used in all cases.

Of the 97 patients with perforated appendices 71 received penicillin at an initial dosage level of 100,000 units every 2 hours. The duration of treatment at this level ranged from 1 day to 26 days with an average of 5.3 days. Twenty patients received smaller initial dosages of penicillin postoperatively while 6 patients in whom contamination of the peritoneal cavity was minimal received no penicillin postoperatively. There was only one postoperative death—a mortality of 1 per cent—among the patients with ruptured appendices and this was due to a massive intestinal hemorrhage on the fifth postoperative day from a crushed and inverted but nongauged stump of the appendix.

It is the authors' opinion that inclusion of penicillin therapy in their routine postoperative treatment of perforated peptic ulcers and perforated ap-

pendices has contributed measurably to the low mortality and low morbidity rates for the two groups. Complications due to spread of the existing infection or development of new infectious processes were almost entirely eliminated. In only 1 of the 8 deaths due to a perforated peptic ulcer did infection play a part, and this was an overwhelming peritonitis from the start. The one death from appendicitis was in no way related to the infection. The most noteworthy observation was the absence of wound suppuration in the ulcer group.

EDMUND A. GORVETT, M.D.

**Nocturnal Gastric Secretion: Studies on Normal Subjects and on Patients with Duodenal Ulcer, Gastric Ulcer and Gastric Carcinoma.** ERWIN LEVIN, JOSEPH B. KREMER, WALTER LINCOLN PALMER, and CARRIE BUTLER. *Arch. Surg.*, 1948 56 345.

The authors present the results of their studies on the gastric secretion of normal persons and of patients with duodenal ulcer, gastric ulcer and gastric carcinoma. A greater free acidity has been observed in the nocturnal secretion of patients with duodenal ulcer than in that of normal patients.

Studies on the continuous 12 hour nocturnal gastric secretion in normal healthy persons without gastrointestinal complaints have not been reported heretofore.

Studies were made on the nocturnal gastric secretion of 33 normal healthy persons who were known to have no gastrointestinal complaints. 21 of the subjects were males and 12 were females.

There are statistically significant differences between the gastric secretion of normal persons and that of patients with duodenal ulcer, gastric ulcer and carcinoma, although as one would expect, there is no overlapping.

The volume of the continuous nocturnal gastric secretion in the group with duodenal ulcers was found to be significantly higher than that in normal subjects. Comparison of the normal group with the small series of patients with gastric ulcer and gastric carcinoma indicates that there is no significant difference in the volume of gastric juice secreted by normal subjects and by those with gastric ulcer. Patients with gastric carcinoma tend to secrete a lower volume of gastric juice than that secreted by normal persons. The continuous nocturnal gastric secretion in patients with duodenal ulcer is much greater than that encountered in patients with gastric carcinoma or gastric ulcer. Patients with gastric ulcer usually secrete a greater volume of gastric juice than do patients with gastric carcinoma.

Similarly the free acidity of the total nocturnal gastric secretion is much higher in patients with duodenal ulcer than in normal subjects. On the other hand the free acidity tends to be lower in patients with gastric ulcer and gastric carcinoma than in normal persons. The free acidity of the nocturnal gastric secretion tends to be higher in patients with gastric ulcer than in patients with carcinoma.

The differences in gastric secretion in the groups studied are most evident with regard to the total amount of hydrochloric acid secreted during the night. Those with duodenal ulcer secrete a significantly greater amount of hydrochloric acid than do normal persons. On the other hand normal persons secrete more hydrochloric acid in the nocturnal gastric secretion than do patients with either gastric ulcer or gastric carcinoma. In both instances the differences are significant. Patients with gastric carcinoma tend to secrete less hydrochloric acid than do patients with gastric ulcer.

The results also indicate a wide individual variation in the volume of gastric secretion and in the output of free hydrochloric acid, even in the same person. However if the correlation coefficient is computed, it becomes apparent that a person with a high secretion on one night will in the majority of instances have a high gastric secretion on successive nights. The same constancy is demonstrated by persons with a low secretory rate.

The great difficulty in ulcer therapy is the control of excessive continued nocturnal secretion. Dragstedt maintains that "the chief abnormality of duodenal ulcer patients lies not in the fact that they secrete more gastric juice in response to the stimulus of histamine or alcohol than do normal individuals, but rather in the fact that they secrete large volumes of highly acid gastric juice when there is no known stimulus to the gastric secretory mechanism. The present data quantitatively confirm these observations with respect to duodenal ulcer (not for gastric ulcer) and are similar to those obtained in the studies of Dragstedt and his co-workers. The two studies were carried out under the same conditions. In a previous investigation Levin, Hamann, and Palmer found that for 38 patients with uncomplicated duodenal ulcer the average volume of the continuous nocturnal gastric secretion was 1130 c.c., with an average free acidity of 65 clinical units.

The earlier work differs from the present one in two respects: first, all the patients had uncomplicated duodenal ulcer whereas 6 of the present group had abnormal gastric retention; second, all the patients in the earlier study were placed on a Sippy regimen while the tests were being made, whereas in the present investigation the patients were given a clear liquid diet. Nevertheless the average volume and the average free acidity were similar in the two groups, the difference being only 1.0 clinical unit. It can be safely concluded therefore that the average volume of the continuous nocturnal gastric secretion in patients with duodenal ulcer is between 1,000 and 1,500 c.c. and that the average free acidity is between 60 and 70 clinical units.

bleeding ulcers but a fair proportion of them may be salvaged by timely surgery.

If one accepts this fact, then two alternatives suggest themselves. One is to operate early upon every patient in whom there seems to be any possibility however remote that the hemorrhage may prove fatal. The other is to limit emergency operation to those patients who seem to be bleeding to death. This latter is the course followed by the authors.

The selection of patients for operation depends upon the rate of bleeding rather than the age of the patient, number of previous hemorrhages, or other various factors. A clinical rule adopted is if the rate of bleeding is such that a stable circulation cannot be maintained with transfusions roughly approximating 1500 c.c. of blood per 24 hours, then spontaneous cessation of the hemorrhage is unlikely and emergency operation should be undertaken.

Knowledge of the source of the bleeding is most important and should be obtained from the history, clinical findings, previous roentgenograms and x-ray examination prior to emergency operation. This is considered a prerequisite for this type of surgery in order to prevent a useless operation.

STEPHEN A. ZICHMAN, M.D.

Results Following Subtotal Gastrectomy for Duodenal and Gastric Ulcer. FORDYCE B. ST. JOHN, HAROLD D. HARTY, JOHN M. FERRER, and R. W. SEIBERT. *Ann. Surg.* 1935, 93.

Partial gastric resections were performed in 394 individuals for peptic ulcer from 1916 to 1935 inclusive. The authors compare the value of vagus nerve resection versus that of gastric resection.

There were 336 satisfactory results among 394 patients. The basis for the analysis of the unsatisfactory results is presented along with a table showing the postoperative complications. Two tables show the causes of postoperative deaths. A further analysis of additional cases shows that from 1916 to 1935 the results were satisfactory in 73 per cent of 55 cases. From 1916 to 1925 59 per cent of the results remained satisfactory.

In these decades various operative procedures were carried out for the same pathology. The authors believe that a high percentage of excellent results have followed gastric resection and that resection is a relatively simple procedure in patients under 50 years of age. It must be remembered that after the age of 45 carcinoma must be considered in the diagnosis. The mortality rate from 1916 to 1935 was 20 per cent from 1916 to 1935 it was 13 per cent from 1916 to 1925 it was 4.6 per cent and

tion at operation. Even with fairly small carcinomas total gastrectomy is the procedure of choice. The utilization of the Roux Y makes possible more radical resections of carcinomas located in the cardia of the stomach. The considerable length of free duodenum obtainable, and the adaptability of the jejunum to esophageal anastomosis make it advantageous in transhiatic resection of the lower esophagus and stomach also. The facility of manipulation of the loop of Roux Y makes it useful in palliative procedures for nonresectable gastric cancers as well. Since the technical execution of the anastomosis is easier with the Roux Y operation mortality should be reduced.

Cases illustrating the advantages of the procedure are presented, and technical details are illustrated with twenty drawings. FRANK B. QUINN, M.D.

**Intestinal Suction Treatment.** S. S. KROOK. *Acta chir. scand.*, 1948, 96: 562.

Five case histories are explained in detail to show the indications for treatment by intestinal suction. The differential diagnosis between obstruction due to strangulation and simple obstruction is very important. The risk in the strangulation cases is markedly increased in direct proportion to the time that suction is used.

The author states that he has used operations in all obstruction cases and is of the opinion that his results are comparable with the best results obtained by suction treatment. Furthermore he sees no reason at present to replace operative treatment with successful outcome by suction treatment in mechanical ileus. He does state however that suction treatment is of value in postoperative mechanical obstruction. In general following operations on the small bowel and in nonmechanical obstructions of all kinds. Suction treatment aids the maintenance of fluid balance.

RICHARD J. BENNETT, JR., M.D.

**Atypical Crohn's Disease.** M. J. BENNETT JONES and G. F. WIGGLESWORTH. *Brit. J. Surg.* 1948, 35: 66.

Atypical Crohn's disease is usually maximal at the termination of the ileum, gradually diminishing in a proximal direction so that the wall of the ileum becomes gradually normal at about 10 to 14 inches from the ileocecal junction. The main modification of the original description is that the cecum and the ascending colon may also be affected. Most surgeons who deal with emergency cases of abdominal disease have encountered the inflammatory phase which causes the symptoms and signs suggesting appendicitis. It is thought that resolution can occur at this stage because many patients in whom the diagnosis was made by laparotomy only have remained symptom-free for a year. The obstructive phase of the disease is less common and may be associated with internal or external fistulas, a gross deterioration in the general condition is the rule in these cases.

From the pathological point of view the disease is not usually difficult to diagnose generally it con-

forms to the classical description of the disease by Hadfield and the diagnosis is made mainly on the macroscopical distribution and the type of lesion together with a histological picture of chronic non-specific inflammation with the exclusion of tuberculosis as far as possible. If atypical lesions are to be found in this disease then difficulties of diagnosis will arise.

The authors present a report of 3 cases of atypical Crohn's disease. Two of them were unusual from a pathologic point of view. CHARLES BARON, M.D.

**Anal Ileostomy with Sphincter Preservation in Patients Requiring Total Colectomy for Benign Conditions.** MARK M. RAVITCH. *Surgery* 1948, 24: 170.

In a lengthy differential discussion of the operations in current use for the control of ulcerative colitis, polypoid adenomatosis of the colon and Hirschsprung's disease the author recommends anal ileostomy in highly selected cases. Two case histories with x-ray illustrations showing that the patients did well 15 and 2 years postoperatively are presented. Sphincter control and absence of cramps were not obtained for about 4 months after the operation at which time the terminal ileum completed physiological dilatation.

A detailed presentation of the technique is made with many photographs. It is essentially a one stage complete colectomy the pelvic floor being remade over the distal segment of the ileum the latter is sutured to the *in situ* external anal sphincter (The anal mucosa and submucosa have been previously dissected away in a 2 to 3 inch cuff by a perineal approach.) It represents a modified Babcock pull through procedure. The procedure may be done in one stage or in two stages with several months intervening between the abdominal and perineal ileostomy formation.

The procedure offers the most help for patients with ulcerative colitis who need colectomy and permanent ileostomy. JAMES C. MACMILLAN, M.D.

**A Case of Intestinal Lipodystrophy (Whipple's Disease) Simulating Boeck's Sarcoid.** BENJAMIN NEWMAN and RUSSELL H. POPE. *Gastroenterology* 1948, 11: 120.

A case is presented of moderately advanced intestinal lipodystrophy (Whipple's disease) which was mistaken for Boeck's sarcoid as a result of biopsy early in the disease. A brief summary of the theories recorded in the literature is presented.

JOHN J. MALONEY, M.D.

**Polyps (Adenomatosis) of the Colon.** PAUL H. HORTON and DANIEL P. SLAUGHTER. *Surgery* 1948, 24: 183.

The experience of surgeons in the operative management of polyposis is reviewed in this article. Seven new cases added to the tabulation of those reported make a total of 35 cases of polyposis found in the American literature since 1930. Analysis of

these shows considerable variability in the chronologic order of the surgical procedures used to accomplish the end results. In some cases the variations were necessary because of manifestations of the disease peculiar to the individual. In others they were caused by failure of the first operator to appreciate the disseminating and premalignant qualities of the disease attention at first being directed to segmental resection. Among all the cases the only two methods resulting in cure were total ablation of the large bowel and external ileostomy or total colectomy and ileocolicostomy (or ileoproctostomy) combined with fulguration of the lower segment.

It is apparent that no attempt should be made to hold one method of treatment in favor over the other except as applied to the individual patient. The method which preserves sphincter function is to be preferred provided rigid conditions for its safety are established. Otherwise it probably should be discarded in favor of the other plan.

Total removal of the large bowel is the method of choice if there is indisputable or even questionable evidence of carcinoma of the rectum or lower sigmoid colon. Even those who favor preservation of the sphincter mechanism in patients with cancer of the rectum probably would not care to precede ileoproctostomy by fulguration of polyps in close proximity to the cancer. Total removal might also be preferred if the rectum exhibits closely set polyps with marked hyperplasia, ulceration, and secondary infection. Under these conditions areas selected for biopsy may not be representative and carcinoma can be overlooked.

Total ablation may be done in one or multiple stages in accord with the health, age, sex, and obesity of the patient, and his course during surgery.

The review indicates that the use of preliminary external ileostomy in patients known to have carcinoma of the sigmoid or rectum is generally undesirable because of the long interval imposed by waiting for systemic adjustment or by management of local complications of the ileostomy before curative resection can be done.

Before it is decided to fulgurate rather than to remove the lower sigmoid and rectum, the presence of cancer should be excluded by careful study of the gross morphology of the mucosa well beyond the rectosigmoid region and of the microscopic anatomy of sections obtained from representative areas. Early carcinoma *in situ* may be difficult to recognize in some cases.

The features distinguishing polyposis of the colon as a disease entity are its tendency to occur in certain families, the diffuse involvement of the colon with polyps and the propensity of the lesions early to undergo malignant change. It can be differentiated from the more frequent occurrence of isolated polyps, cancer and inflammatory diseases of the colon and rectum by a careful history stool examinations, sigmoidoscopy and roentgenologic study after barium and air enemas.

The cure of polyposis depends upon the recognition of this disease entity and its differentiation from other diseases before surgical management is planned. Failure to do this may result in inadequate treatment. Surgery should be directed toward either total ablation of the large bowel or total colectomy and ileosigmoid (ileorectal) anastomosis combined with fulguration of the polyps in the preserved segment.

Early recognition of the disease and the increased amount of surgery that can be performed in one stage because of modern therapeutic adjuncts to intestinal surgery combine to give an improved prognosis in polyposis of the colon. STEPHEN A. ZINKEAS M.D.

**Spreading Ulceration of the Skin Associated with Idiopathic Ulcerative Colitis.** E. C. B. BURTICK. *Proc. R. Soc. M. Lond.*, 918, 41-474.

Progressive ulceration of the skin is a rare but important complication of ulcerative colitis. In the 8 patients whose cases are reported, the ulceration was severe but it is evident from the literature that all grades of skin involvement may occur in association with ulcerative colitis. Other mild cases have been observed in which the ulcers were not painful and healing occurred rapidly with rest and chemotherapy. In the 8 cases presented, the clinical picture was unmistakable. It is the author's belief that these severe skin lesions may endanger the life of the patient.

The ulceration seems to occur in patients who have suffered from colitis over a considerable period of time. In the authors' cases, and in others reported elsewhere, the skin ulceration commenced during a exacerbation of the colitis, as shown by pyrexia, diarrhea and rectal bleeding. Healing of the ulcers appeared to depend on cessation of the active phase of the colitis—following medical treatment in one case and following colectomy in the other. In the second case a relapse of the colitis was accompanied by exacerbation of the skin ulceration.

These facts clearly suggest that the skin lesions are in some way linked with the colitis. It is possible that several factors are involved. First, there may be a deficiency due to a lack of biosynthesis of certain vitamins in the diseased bowel secondly the original skin lesion may be an allergic phenomenon similar to that which originally may have caused the colitis. This view is supported by the fact that in one case the discharge from the ulcer was sterile for several days, which was against a diagnosis of primary bacterial infection. Thirdly, lowered resistance of the patient to infection, coupled with secondary anemia, undoubtedly promotes the incidence of the severe secondary infection which so often occurs in these cases.

In the first case cultures from the lesion were sterile for some days before pyogenic infection occurred. The second patient was not admitted to the hospital until secondary infection was well established. Cultures showed, at various times,

staphylococci hemolytic streptococci *Bacillus proteus* and *Bacillus pyocyaneus*. The lesion begins as a raised red papule which rapidly breaks down to form a small ulcer. In mild cases no further spread may occur but in others the discharge becomes profuse and the ulcer rapidly increases in size. Severe pain is a predominant symptom. The commonest sites for infection to occur are the limbs but any part of the body may be affected. Unless the condition is checked the ulcer may spread until the patient is in danger of death from toxemia and anemia. Spontaneous arrest may take place if there is clinical improvement in the colitis but in severe cases energetic local and general treatment is required to halt the spread of the ulceration. Once the infective process has been healed epithelium rapidly grows in from the edge of the ulcer but skin grafts may be required when the lesion has been extensive.

Severe lesions must be treated vigorously the first patient nearly died because the diagnosis was not made early enough. If the colitis is in an acute stage medical treatment will probably suffice. Diet should include a high protein content, low residue and plenty of essential vitamins. Oral sulfonamides and systemic penicillin should be given in the author's 2 cases however the results from chemotherapy were disappointing. It is possible that larger amounts of penicillin, say one million units daily might have given a more favorable result. Repeated blood transfusions are essential to combat the secondary anemia. If the patient does not improve ileostomy should be considered. In more chronic cases (as in Case 2) surgical treatment may be required more frequently since the skin lesions may relapse with each exacerbation of the colitis. Necrotomy may be required and colectomy is often advisable. Locally the treatment which appeared to stop the spread of the ulceration was excision of the whole of the edge with a diathermy knife. The result was dramatic pain vanished the edge of the ulcer became clean and clear-cut, and the response to local chemotherapy was good.

At operation the limbs should be raised to avoid considerable blood loss from venous oozing. These patients do not tolerate loss of blood and every effort should be made to prevent undue hemorrhage. Blood transfusion is advisable during the operation. Excision with an ordinary knife may be equally satisfactory, but the diathermy appeared useful in the prevention of blood loss. Complete excision of the whole ulcer including the base followed by immediate skin grafting may be successful. Postoperative therapy consists in repeated application of penicillin sulfonamide powder with early skin grafting if necessary. CHARLES BARON M.D.

#### Congenital Obstruction of the Colon in an Adult

DOUGLAS K. REID *Brit J Surg* 1948 36 52

A case is described in which chronic intestinal obstruction in an adult was found to be caused by two congenital diaphragms of the ascending colon.

The commonly accepted etiology of both atresia and stenosis concerns the epithelial proliferation which takes place in the second month of fetal life to the extent of obliteration of the lumen, which later becomes re-established by absorption of excess tissue. Incomplete reabsorption can readily be understood to leave behind such diaphragms as are described in the present case.

Congenital occlusion of any part of the gastrointestinal tract is an extremely rare cause of symptoms in adult life. CHARLES BARON M.D.

#### Urologic Complications of Left Colon Surgery

CLARENCE G. Bandler and PHILIP R. ROEM *Ann Surg.*, 1948, 128 80.

Urologic complications of surgery of the descending colon particularly in abdominalperineal resection are more frequent than is commonly acknowledged. An incidence of 30 per cent of urinary complications would seem to be average and three-fourths of these cases occur in males. The urinary tract complications include injury to the ureter with resultant ureteral fistula, trauma to the bladder causing vesical urinary fistula and vesical dysfunction.

Ureteral damage occurs more often on the right side probably because the surgeon working on the descending colon is more meticulous in identifying the left ureter. When ureteral injury occurs and is at once recognized at the time of the colon surgery, end-to-end anastomosis or repair of the ureteral opening should be made over a splinting catheter, the end of which is passed down into the bladder and removed cystoscopically at a later date when healing has been established.

When bladder invasion by the carcinomatous tissue is found either at preoperative cystoscopy or during operation, the location of the invaded area will determine whether the situation is operable or not. When the dome or posterior wall is involved partial resection of the bladder may be performed. When the malignancy involves the trigonal area, the prostate or seminal vesicles the condition is usually "inoperable." Inadvertent injury to the bladder wall may occur incidental to the operative procedure on the colon. A suture may be taken through the bladder wall with subsequent necrosis and the production of a vesicle fistula. Conservative management with the use of an indwelling catheter is indicated and spontaneous healing will occur as a rule.

The most common urinary complication is the bladder which is unable to empty itself which becomes infected or both. This is due to (1) injury of the autonomic nervous system during excision of the distal colon (2) direct trauma to the bladder (3) prostatic obstruction or (4) postoperative sagging of the bladder.

Postoperative management consists of insertion of a soft self-retaining catheter 16 to 18 F., for about 5 days. If at the end of this period residual urine in excess of 100 c.c. is noted the catheter should be reinserted. Sulfadiazine (gm 0.5) every 4 hours with an equal amount of sodium bicarbonate should



be given to combat the inevitable infection. If vesical neck obstruction is present transurethral resection should be performed.

ELY ELLIOTT LAZARUS, M.D.

**The Role of Hypertrophy of the Muscularis in the Delayed Onset of Symptoms in Cancer of the Colon.** JOHN ARMES GRIS. *Surgery* 94, 24 221

Struck by the fact that carcinoma of the colon can progress to an incurable stage before the patient (even a fellow surgeon) becomes aware of his trouble, Gris undertook a study to elucidate the reason for this lack of symptoms. A perusal of the literature showed that Nothnagel had ascribed the absence of symptoms to hypertrophy of the colon. Experimentally Hertzell had shown that detectable hypertrophy of the muscles resulted from incomplete obstruction after 5 days while grossly visible hypertrophy was observed in 9 days. It was emphasized that hypertrophy and not hyperplasia is the essential change.

Although Morrison and Saint (1935) as well as Osgood (1940) had discussed the principle of muscle hypertrophy and compensation as it applies to stenosis in hollow viscera and stressed its fundamental importance, this concept has been either forgotten or regarded as of only academic interest. In fact, no reference to this work is made in textbooks and standard works pertaining to medicine and surgery.

During the past year Gris studied about 20 unselected specimens of cancer of the large bowel. Inspection revealed gross thickening of both the circular muscle layer and of the longitudinal tenia. This thickening was most marked in the proximal bowel and increased in size as the tumor was approached. There was also some increase in the thickness of the muscle wall below the tumor. Microscopic sections were taken 5 cm from the tumor margin through the wall proximal and distal to the tumor. The muscle layers were increased in thickness without evidence to indicate that edema or cellular infiltration was responsible for this change. The cytoplasm of the individual muscle cells was increased, was somewhat paler-staining than the cytoplasm of normal cells and appeared vacuolated. The nuclei were elongated and larger than normal. They were spaced at greater intervals and were hyperchromatic.

Thickening of the muscle coat of the large bowel proximal to a cancer of the colon with stenosis was an impressive finding. The extent of muscular thickening appeared to be related to the duration and degree of stenosis and was the logical result of the increased work demanded of the muscle. It is believed that the effects of the stenosis may be minimized by the increased propulsive power of the bowel wall and thus the symptoms of increasing obstruction are masked for some time. This mechanism of compensation may delay the onset of significant symptoms until curative surgery is no longer possible.

ROBERT TURELL, M.D.

**Cancer of the Colon. Elective Surgical Treatment.** (Cáncer del colon. Elección de operación para su tratamiento.) J. GARCÍA MORALES. *Rev. esp. cir.* 94, 51 17

The author discusses the decreased mortality following surgical treatment of cancer of the colon. This improvement is attributed to earlier diagnosis, the use of antibiotics, better general anesthetics, and to the better knowledge of preoperative and postoperative management. He mentions the findings of Puig Sureda of Spain who in 60 colectomies has had no mortality. The author discusses the anatomical irrigation of the colon, the incidence of localization of the tumors in the colon, and the common development of cancer in polyps of the bowel.

Different methods of surgical treatment are indicated according to the location of the tumor in the colon. In cancer of the cecum and ascending colon resection of the terminal ileum with the ascending colon and cecum is performed. Tumors of the transverse colon usually are resected and an end-to-end anastomosis is established. In cancer of the splenic flexure a transverse colectomy or a colectomy previous to the resection is advised, and in cancer of the descending and pelvic colon a resection with an end-to-end anastomosis is carried out.

WILLIAM E. RICHKETT, M.D.

**Rectal Prolapse (Prolapso rectal).** PABLO ILIESTE. *Arch. Soc. cir. hep.* Santiago 1943, Supp. 6 3

The author discusses the results obtained with different methods of surgical treatment in 22 cases of prolapse of the rectum. In cases in which the prolapsed rectum presents signs of strangulation, and in which multiple and extensive ulcerations occur in the prolapsed mucosa, or those in which the prolapse is due to a malignant tumor, the elective treatment is either resection or extirpation. In other cases, various methods of colpopexy such as the Quenu Duval or Mayo operation, or the perianal operation of Lockhart-Mummery were found to be the most valuable.

WILLIAM E. RICHKETT, M.D.

**Evaluation of Coloproctectomy and Immediate Anastomosis of the Rectum.** R. RUSSELL BERT. *Arch. Surg.* 94, 56 68

Forty years ago the objective in extirpation of rectal carcinoma was preservation of the sphincter mechanism and re-establishment of bowel continuity except when the anal canal was primarily involved. At that time a wider excision of tissues in the zones of lymphatic spread accomplished by the more radical abdominoperineal excision including the entire area of the sphincter muscle and establishment of a permanent abdominal colostomy resulted in a decided increase in the percentage of cure. This Miles operation in one or two stages, continues to be the most popular procedure.

Sporadic attempts are constantly being made to develop a technique which would be sufficiently radical to extirpate all malignant tissue, and yet would preserve the mechanism of the sphincter

muscle. The true basis for the renewed attempts at re-establishing bowel continuity is the study of lymph nodes in this type of malignant condition. This reveals that dissemination of cancer cells of the rectum in a downward direction is unusual unless the nodes above the tumor are blocked by metastases.

The intramural spread of cancer cells below the margin of the tumor also is rare. A clearance of from 1 to 2 inches is usually a safe margin. Laterally lymph nodes extend outward over the upper surface of the levator ani muscle to the hypogastric nodes and cancer cells could spread into these nodes. In lesions situated in the last 3 inches of the rectum removal of at least part of the levator should be considered. With lesions at the 3 inch level or higher in the rectum, the levator fascia and muscle should be excised.

In the evaluation of procedures for preservation of sphincter muscle and function, one must examine the rates of mortality 3 and 5 year survival and morbidity the degree of continence and the element of impotence in males. The incidence of mortality reported in the one stage abdominoperineal resection and in the various types of radical abdominoperineal operations with sphincter preservation varies from a low of 4.9 per cent to a high of 22.1 per cent.

With use of the radical abdominoperineal excision that Miles advocated, the 3 and 5 year cures average about 50 per cent. Satisfactory and comparable results of the sphincter preservation operation however cannot be determined until another 5 or 10 years have passed.

At present it appears that satisfactory continence may be expected in from 80 to 90 per cent of cases in which anastomosis is completed in sphincter saving procedures.

Impotence in males is a very frequent complication following abdominoperineal resection. This complication does not arise as frequently when the sphincter is preserved.

If an operation of the anastomotic type is decided upon one of three procedures may be selected: (1) abdominal dissection, resection and anastomosis, (2) abdominal dissection with perineal resection and anastomosis and (3) perineal dissection with perineal resection and anastomosis. In lesions of the rectosigmoid and immediately adjacent lesions of the upper part of the rectum, dissection and anastomosis can be accomplished from within the abdomen. Likewise lesions lower than the upper part of the rectum—within 2 inches—can be resected and abdominal anastomosis accomplished but lesions at the 3 inch level (midrectal) should have abdominal dissection and posterior resection with anastomosis to insure adequate removal of lymph nodes or infiltrated tissues of the levator ani muscle and fascia. The strongest support for perineal dissection with perineal resection and anastomosis is its expediency in a patient who is a poor risk.

SAMUEL KAHN, M.D.

**Resection of Rectum and Rectosigmoid with Preservation of the Sphincter for Benign Spastic Lesions Producing Megacolon** OVAR SWANSON and ALEXANDER H. BILL, JR. *Surgery* 1948, 24: 218

By the use of special roentgenologic technique it was possible to demonstrate an area of spasm in the rectosigmoid or rectum at the lower limit of the area of dilatation of the colon in 20 patients with a clinical diagnosis of Hirschsprung's disease or congenital megacolon.

The disease was characterized by severe constipation with bouts of obstipation dating back to early infancy and tending to become more severe and distressing as the children grew older. Malnutrition in various degrees was present. The length of bowel involved and the degree of spasm probably account for the variations in the severity of the disease.

In the milder cases treatment with a regimen of mechoyl mineral oil, and enemas was successful. In the severe form of the disease excision of the spastic area of the bowel with re-establishment of bowel continuity offers a satisfactory means of treatment. A method of resection which permitted removal of the rectosigmoid and rectum with preservation of the anal sphincter is described.

After animal experimentation with excellent results 3 children were subjected to resection in which the bowel was divided just above the constricting area. The distal segment was everted through the anus and a small transverse incision made 1 cm. from the anal skin. By means of a long forceps the proximal bowel segment was pulled down and anastomosed to the distal portion the redundant pouch and spastic area being removed. The bowel was then put back into the pelvis the peritoneum sutured about it, and the abdominal incision was closed. Normal bowel movement without the aid of diets laxatives enemas or therapy followed.

It is concluded that the method will be a useful adjunct in the treatment of benign lesions of the rectum and rectosigmoid such as severe spasm. It may have no place in the treatment of carcinoma except perhaps for localized small lesions.

In the technique of the operation the most important step is to be certain that the blood vessels to the proximal end of the bowel are of adequate length to permit the sigmoid to be pulled out through the anus. It is also important that the anastomosis be done in two layers with extreme care to make sure that there be no leakage into the pelvis.

STEPHEN A. ZIMMAN, M.D.

**Rectal Cancer and the Preservation of Function** E. G. MUIR. *Brit. M. J.*, 1948, 2: 286

There is a sound pathological basis for operations which aim at preserving a functioning anus in high rectal and rectosigmoid growths but, even in early cases and with adequate excision carcinoma can reappear at the anastomotic site.

To be certain of continence the anorectal ring must be preserved. Of the various methods devised abdominal resection anastomosis and a pull through

resection appear to be preferable. A preliminary transverse colectomy lessens the risk and dangers of infection, and should always be employed.

The use of sulfonamides and penicillin has reduced the mortality with all methods of rectal resection to a low figure. SAMUEL KAHN, M.D.

### LIVER, GALL BLADDER, PANCREAS, AND SPLEEN

**Experimental Repair of Common Duct Defects Utilizing a Free Vein Graft Over Blakemore-Lord Tubes.** PATRICK C. SHEA, JR., and CHARLES A. HURAY. *A. S. Surg.* 1948, 8:2.

The treatment of common duct stenosis is difficult in itself but becomes increasingly so when a defect must be bridged. Many methods of repair have been devised using vein grafts, fascial grafts, rubber tubes, vitallium tubes, and adjacent hollow viscera. These methods have not proved completely satisfactory since bile encrustations, contraction, or complete stenosis and obstruction have resulted.

The authors experimented on dogs, bridging common duct defects by the employment of a free vein graft over a Blakemore-Lord tube. It was postulated that epithelialization of the intima of the vein segment with biliary tract epithelium would occur and that the blood supply to the graft would be supplied by vascularization of connective tissue and from peritonization of the graft and surrounding area.

The series comprised 21 dogs, all of which were examined after death or sacrificed at the end of the experimental period. All dogs that survived the experimental period of 10 to 120 days showed the graft to be completely covered with peritoneum, and in 66.7 per cent of the total number of animals the bridging channel remained functionally patent and a free flow of bile was maintained.

ELY ELLIOTT LARSEN, M.D.

**Conservative Therapy of Residual Calculi Following Operations on the Common Bile Duct.** GERALD H. AMSTERDAM and JULIAN A. STEERLING. *Ann. Surg.* 1948, 28:30.

The authors state that several reports have been published on the occurrence of residual cholelithiasis following operations on the common bile duct. The stones may not have been observed or may have been inaccessible at the time of operation.

These calculi can produce total obstruction to bile flow although the obstructive phenomena are usually incomplete and intermittent. Some stones may disintegrate, others may pass into the gastrointestinal tract through the papilla of Vater or via a fistula, others still may become imbedded in the wall of the papilla or may remain as asymptomatic foreign bodies.

It is advisable to avoid secondary procedures on the biliary tract since the risk of reoperation is great and the technical procedure is frequently very diffi-

cult. Lavage of the common bile duct through an individual "T" tube can be expected to produce excellent results in the therapy of residual cholelithiasis, if given a trial for a sufficient length of time.

The technique consists of irrigating the common bile duct with 3 to 4 c.c. of ether one or two times daily. It should be noted that ether boils at body temperature and this phenomenon may cause discomfort since the expanded vapors can exert considerable pressure. If discomfort occurs the syringe may be disengaged and the ether permitted to bubble out the open end of the "T" tube. Nitrites may be administered for the relief of pain or to relax sphincteric action.

Two cases of residual cholelithiasis are reported. In one of these, daily instillations of ether for a period of 2 months were followed by disappearance of the stone. In the other, instillations were continued for 7 months.

ELY ELLIOTT LARSEN, M.D.

**Operative Diagnosis of the Indurations of the Duodenopancreas (Diagnóstico operatorio de las induraciones del duodeno-páncreas).** LORENZO II MAR TARELLA. *Prisma Med. Argent.* 1948, 35:98.

The continuous advances in the diagnosis and treatment of lesions of the head of the pancreas have led to a modification of the topographic concepts of the area, and to the creation of a new anatomic entity, the duodenopancreas which consists of the second portion of the duodenum and the head of the pancreas, and possesses a neurovascular individuality which facilitates the operative diagnosis of indurations of the area and the treatment to be applied. Since tumors as well as inflammations of the area produce similar indurations, the author has endeavored to establish clearly an operative differentiation between them in order to avoid the previously made mistake of performing pancreatectomy in an inflammatory process. To improve the possibilities of correct diagnosis any surgeon who performs a laparotomy should also do a routine palpation of the head of the pancreas to enable him to recognize its normal consistency as a result he will find it easier to locate a lesion which has remained silent.

To make a good exploration of the area it is necessary to retract the stomach and liver upward and the transverse mesocolon downward and to palpate the region by inserting the index and middle fingers behind the duodenopancreas (in the diaphragmatic angle formed by the peritoneum on passing from the external aspect of the second portion of the duodenum to the posterior wall) and placing the thumb in front. The normal pancreas has a consistency similar to that of the intestine which surrounds it. When an induration is discovered or suspected, an opening must be made through the gastroduodenal epiploic freeing the stomach from the transverse colon in its right half and exposing the duodenopancreas and the remainder of the pancreas.

Once the presence of a pancreatic induration is confirmed it should be classified as being purely pancreatic, or duodenopancreatic or belonging to the region of Vater's ampulla. The symptomatology of each type will furnish information of great interest but the clinicosurgical pictures will be of greater importance. They include

1 Patients presenting symptoms and the diagnosis of biliary lithiasis but without jaundice in whom at operation calculi are found in the gall bladder and a nodular induration is observed in the head of the pancreas. These are cases of chronic pancreatitis secondary to lithiasis.

2 Patients presenting the same symptoms but with jaundice in whom operation reveals gall bladder or choledochus lithiasis with induration in the head of the pancreas either nodular or total, generally elastic and with hardly any increase in size. Choledochotomy should be performed to make sure that the induration is not due to calculus in which case there is again a secondary pancreatitis.

3 Patients with painless jaundice and a diagnosis of tumor of the biliary or pancreatic ducts in whom the biliary ducts at operation are found to be of normal appearance whether dilated or not, and an induration of the duodenopancreatic area is revealed. The chances are that the induration is due to cancer.

The maneuvers that should be carried out in the exploration of the duodenopancreatic induration are the following: exposure of the duodenopancreas, trocar puncture of the induration, biopsy of the pancreas (this was done in 15 cases), biopsy of peripancreatic lymph nodes, biopsy of hepatic metastases if they are not of typical aspect and exploratory duodenotomy (this was done in 8 cases).

Tumors of the head of the pancreas were observed in 57 cases. They may involve the entire head (this occurred in 45 cases) or only part of it. These lesions develop around the choledochus are called choledochopancreatic tumors, and were found in 21 cases. Those in the lower half of the head called infracholedochal tumors are rare and one typical case was observed. Eight cases of duodenopancreatic tumors were studied. Tumors in the region of Vater's ampulla were found in 9 patients and could be felt by palpation or recognized at the level of the second portion of the duodenum as demonstrated in 7 cases; the other 2 tumors were not palpable and were discovered only through an exploratory duodenotomy.

RICHARD KEMEL, M.D.

**Acute Pancreatitis—A Critical Analysis of 15 Cases**  
FRANK W. BLATCHFORD, JR. and FREDERICK CROSTOFER. *Q. Bull. Northwest. Univ. M. School* 1948, 22: 198.

A critical review of 15 cases of acute pancreatitis in patients seen at the Evanston Hospital, Evanston, Illinois from 1938 to 1947 inclusive is given by the authors.

The great frequency with which this disease is associated with biliary tract disorders has been noted. Removal of a diseased gall bladder and of gall stones

is the logical prophylactic treatment of pancreatitis. Four cases of obstruction of the common duct secondary to acute pancreatitis are presented in support of the view that acute as well as chronic lesions of the pancreas can obstruct the common bile duct.

The great importance of the serum amylase test as the only pathognomonic sign of acute pancreatitis is emphasized.

From this study it appears that conservative (nonsurgical) treatment is preferable in cases of acute pancreatitis. Surgical treatment is to be considered in cases of pancreatic abscess and when there is continued and increasing evidence of sepsis.

JOHN J. MALONEY, M.D.

**Chronic Relapsing Pancreatitis.** R. E. HORTON  
*Guy's Hosp. Rep., Lond.* 1948, 96: 226.

The clinical picture of acute fulminating pancreatitis is well recognized by all physicians; however, the author of this article stresses the point that there is a gradation of severity from the familiar acute phase of the disease to a less often recognized subacute pancreatitis which is characteristically a relapsing disease.

In the course of the inflammatory process pancreatic tissue is destroyed. Healing takes place by replacement of pancreatic parenchyma with fibrous tissue and some regeneration of epithelium also takes place. Successive attacks are followed by an increasing replacement of parenchyma with abscess formation. Impairment of pancreatic function and calcification of areas of fat necrosis are the result of recurring attacks.

The clinical picture may be difficult to recognize and, in typical cases, closely resembles recurrent cholecystitis with cholelithiasis. Recurrent severe upper abdominal pain is characteristic. Jaundice is uncommon and a normal cholecystogram is usual. An elevated serum amylase or lipase is almost pathognomonic of pancreatitis but must only be relied upon early in the course of the disease.

Treatment may be summarized by stating that an operation of internal biliary drainage offers a fair chance of curing the symptoms. Should this be unsuccessful, thoracolumbar sympathectomy may be performed. Pancreatectomy should be reserved for patients suffering from severe pain which is unrelieved by less radical measures.

Seven cases of relapsing pancreatitis are reported by the author. One patient died in a more acute attack; 4 others were treated by cholecystenterostomy and one of these died following operation. The other 3 patients have been relieved—2 completely and 1 incompletely. Two patients continue to be observed.

EDWARD F. LEWIS, M.D.

**Tumors of the Spleen and Pseudotumors of the Spleen** (Rates tumorales and pseudo-tumorales). EMILIE HOUZE and MICHEL FONTAN. *Bruxelles med.*, 1948, 28: 903.

The authors present 3 similar case histories complete with a microscopic description of lympho-

sarcomas of the spleen representing true primary tumors (Cases 1 and 2) and contrast them with "pseudotumors of the spleen caused by splenic thrombosis (Case 3). In a review of the cases, the authors conclude that there are few clinical clues to decisively determine which type of splenic enlargement is present prior to operation, but an elaborate histologic characterization of the two types of tumors is given.

In the first case a lymphosarcoma, grossly about 14 times normal size was filled with millimeter sized nodules which surrounded the central vessels. The malpighian corpuscles could not be distinguished and the nodules were composed microscopically of lymphoblasts, thus presenting the characteristics of a lymphoblastic sarcoma.

The second true splenic tumor described was also a lymphosarcoma having a similar gross and surgical appearance to the first described lymphosarcoma but the predominant cell type was a small round-cell, uniformly dispersed throughout the organ and comprised of lymphocytes of more nearly adult age.

The third case was one of splenic thrombosis in which the removed spleen was about seven times the normal size and, except for marked hemorrhage on cut surfaces, was not strikingly characteristic in gross pathological description.

Photomicrographs are shown to illustrate a congestive type of splenomegaly without reticular hypertrophy with hemorrhage as the predominant characteristic.

The authors indicate that they have obtained satisfactory surgical results in the removal of true tumors of the spleen, but that the pseudotumors as they term the intrasplenic thromboses can be remedied only if operation is done early before

thrombotic processes have extended into the splenic or portal veins. They believe that there is a considerable latent period in the splenic thromboses of the infectious type which may continue for a considerable length of time before extension develops, this stage of latency being characterized by splenomegaly only. The authors present the idea that this should be considered as a syndrome and an indication for splenectomy before fatal extension of the thrombosis occurs.

JANE C. MACMILLAN, M.D.

#### MISCELLANEOUS

Experimental Biliary Peritonitis (S 1 coleperitonitis sperimentale) GASPARE BUCCELLATO. *Polidisco* ser. kir. 945, 55 33

Eighteen dogs were divided into 7 series and treated by ligation of the common bile duct injection of the gall bladder with cultures of the *Bacillus coli*, cultures of the *Bacillus Eberth*, extracts containing pancreatic enzymes sterile glycerine or combinations of these procedures. The experimental period varied from 7 hours to 33 days.

Histopathological examinations revealed no evidence of the passage of bile through the wall of the gall bladder notwithstanding the presence of edema, necrosis, ulceration, and septic thrombi. Biliary peritonitis was found only in a single animal in which gross perforation of the gall bladder as well as of two intrahepatic ducts had developed. It was concluded that biliary peritonitis does not occur without perforation. The cause of perforation is a constitutional predisposition, with the determining factors of biliary stases, reflux of the pancreatic juices or the presence of infection in the gall bladder.

EDITH B. FAIRBORTH, M.D.

# GYNECOLOGY

## UTERUS

**The Application of a Silver Carbonate Stain for the Diagnosis of Uterine Cancer by the Vaginal Smear Method.** H. S. YU, G. M. RILEY, NORMAN F. MILLER, and K. SCHARENBERG. *Am J Obst.*, 1948, 56 468.

The diagnosis of cancer of the uterus by the vaginal smear method is based on the fact that the superficial cell layers of the tumor are subject to early and continuous exfoliation. The malignant cells, once separated from the parent tissue, become mixed with the secretions of the uterus and cervix, find their way into the vagina and may be recognized in properly stained smears of the vaginal fluid.

A review of the criteria diagnostic of malignancy indicates that much reliance is placed upon cell conformation, cellular arrangement, and nuclear characteristics. Obviously any stain or combination of stains which would uniformly delineate cellular outline and afford contrast between the nucleus and cytoplasm could be satisfactorily applied to the vaginal smear technique.

The silver carbonate stain method of Horteza was modified for staining the cellular elements of vaginal smears. The affinity of chromatin material for the silver stain, together with the usual hyperchromatic character of atypical cells makes this a useful stain in the diagnosis of cancer by the vaginal smear method.

JOHN R. WOLFF M D

**Aspects in the Treatment of Vulvar and Cervical Carcinoma.** GRACE C. DOWNHILL and W. A. G. BAULD. *Am J Obst.*, 1948, 56 494.

This report is a survey of carcinomas of the vulva, carcinoma in the cervical stump, and selected cases of carcinoma of the cervix treated by irradiation and surgery at the Radin Clinic, Royal Victoria Memorial Maternity Hospital McGill University, Montreal, Canada.

Treatment of the inguinal glands either by surgery as recommended by Taussig, or by x-ray irradiation as is now being done in this Clinic should be the initial treatment of carcinoma of the vulva and is to be followed by vulvectomy. Local recurrences of carcinoma of the vulva, particularly after vulvectomy have been few. On the other hand subsequent inguinal gland metastasis have not been infrequent.

The reported incidence for true stump cancer at this Clinic is in relation to all cases of carcinoma of the cervix, 4.21 per cent. The incidence in relation to subtotal hysterectomy is 1.2 per cent. Thirty-nine per cent of 28 patients with true stump carcinoma were known to have had bilateral oophorectomy with the subtotal hysterectomy and therefore could reasonably be considered to have had no ovarian tissue at the time the carcinoma developed.

There were no cases of true cervical stump carcinoma in stage 1. The majority were in stages 3 and 4.

These figures suggest that the patient may develop a false sense of security following operation and be more prone to disregard subsequent symptoms.

The majority of cases of cervical carcinoma were treated by radium irradiation and panhysterectomy. There was no dissection or extirpation of the glands or other pelvic structures. This group includes stage III cases. The survival rate has been improved by the use of this method. In a selected series treated in this way the 10 year cure rate was 41.6 per cent.

JOHN R. WOLFF M D

## ADNEXAL AND PERIUTERINE CONDITIONS

**Theca Cell Tumors of the Ovary with a Report of 15 Cases and a Review of the Literature.** WILLIAM R. KNIGHT III. *Am J Obst.* 1947 56 311

Fifteen cases of theca cell tumor of the ovary seen at the Wisconsin General Hospital, Madison, are reported. These cases were discovered by reviewing all specimens previously called fibroma of the ovary. The distinctive diffuse yellow color seen on section of the theca cell tumors is the best gross diagnostic criterion and was present in all of the cases.

This tumor occurs most frequently in the fifth and sixth decades. 61.5 per cent of the patients being past 50 years of age.

In the one case so analyzed, estrogenic substances were found in the tumor. Progesterone was not present in the tumor nor was pregnandiol found in the urine. Although the estrogen produced by the thecoma is small, its effect is prolonged and unopposed by the action of progesterone, which may account for the symptoms and frequent occurrence of associated conditions such as menstrual irregularities, postmenopausal bleeding, endometrial hyperplasia, adenomyosis, hypertrophy of the myometrium with uterine enlargement, uterine myomas, and endometrial carcinoma.

Uterine curettage should be done in all cases to rule out associated adenocarcinoma of the endometrium.

Conservative surgery is the procedure of choice in the premenopausal patient in the absence of associated adenocarcinoma of the endometrium. In the presence of the latter, total hysterectomy is always the operation of choice.

The collected evidence is not conclusive as to whether theca cell tumors represent a distinct histologic type of ovarian neoplasm. This subject warrants further study since the active principle of both theca cell tumor and granulosa cell tumor is estrogen.

JOHN R. WOLFF M D

**Solid Teratoma of the Ovary with Report of 5 Cases.** EDMUND R. NOVAK. *Am J Obst.*, 1948, 56 300.

Although dermoid cysts of the ovary are common, their malignant counterpart, the solid teratoma or

teratoblastoma, is decidedly rare. Of the 5 cases reported by the author, 1 was a private one, 3 were from the gynecological service of the Johns Hopkins Hospital, and 1 was from the Lane Home for Invalid Children at the Johns Hopkins Hospital and were the only cases encountered in these institutions in the past 30 years.

The histologic differentiation between dermoid and teratomatous tumors is sometimes difficult. The word teratoma should be confined exclusively to the solid type of tumor and should be considered malignant by definition.

Teratomas are highly malignant neoplasms from 50 to 75 per cent of them terminating fatally. They occur most often in young individuals and are usually unilateral. Although encapsulated they tend strongly to perforate the capsule and spread both by extension and metastasis.

Radiotherapy seems to help very little. The treatment of choice is still radical surgery and deep x ray therapy. In 4 of the 5 cases reported the patients died. In the fifth case it was difficult to say whether the tumor was a teratoma or a slightly malignant dermoid tumor.

JOHN R. WOLFF, M.D.

#### EXTERNAL GENITALIA

##### Use of the Vaginal Smear as a Screening Test.

HERBERT L. LOWMAN, MARGARET MINDUSTOX, SEYMOUR WARREN, and OLIVE GATES. *N. England J. M.* 1945, 39:37.

This article is a preliminary report on a study being conducted by the Massachusetts Department of Public Health to evaluate the vaginal smear method of cancer diagnosis. In a 2.5 year period 3,586 women were examined. There were 454 patients with a known history of uterine cancer, 123 patients with known cancer in the organs adjacent to the genital tract, and 153 patients in whom the smears were unsatisfactory for examination. Of the remaining 2,876 patients 1,364 gave symptoms suggestive of gynecologic disorders, and 1,512 had no symptoms.

From the 1,512 patients without symptoms there were 8 positive smears, but only 3 were confirmed by biopsy. From the 1,364 patients with gynecologic symptoms there were 133 positive smears, 89 confirmed by biopsy. In 17 a clinical diagnosis of carcinoma was made without biopsy. There were 57 patients in whom a diagnosis of carcinoma could not be made.

The authors review the results in the large series of cases presented by Papanicolaou and Traut, Meigs and Gates and Warren. The errors encountered show that a false negative diagnosis is made from 5 to 20 times more frequently than a false positive diagnosis. Careful re-evaluation of the smears which were only suggestive showed errors in diagnosis. However the smears which showed atypical but not distinctly malignant cells were reported and biopsy was recommended. There were 361 cases in this category but the follow-up has not been of sufficient time to

show whether these will eventually be premalignant lesions.

The authors believe that the vaginal smear method will not bring out many cases in apparently well persons, but that its use has widened the understanding of the early symptoms and signs of carcinoma.

GEORGE B. BRADSTOCK, M.D.

##### Primary Melanoma of the Vagina, with a Review of the Literature. ROBERT A. MINKO, VICTOR H. MINKO and ROBERT G. LATHROP. *Am. J. Obst.* 1945, 56:35.

A case of primary melanoma (melanosarcoma) of the vagina in a 58 year old housewife is reported from the Protestant Deaconess Hospital, Evansville, Indiana. This patient was first seen in May 1944, because of a persistent yellow vaginal discharge occasionally streaked with blood during the preceding 10 month period. Pain in the vagina and bleeding also followed coitus. Examination revealed a superficially ulcerated nonpigmented, rounded, flat tumor 3 cm. in diameter about 1.5 cm. within the vaginal introitus on the midpart of the left lateral wall. Removal of this growth was done and the pathologist reported a benign glandular tumor of the vagina.

Thirteen months later a recurrence was discovered just anterior to the operative scar. Excision of this tumor followed by pathologic study revealed the melanoma. Radical surgical treatment consisting of excision of the local growth, followed by vulvectomy and radical dissection of both groins was performed.

Seventeen previously recorded cases are also reviewed. Radiation was not used because of the poor results obtained in other cases.

Eighteen months after radical surgical therapy this patient is alive healthy and free of this disease.

JOHN R. WOLFF, M.D.

#### MISCELLANEOUS

##### Dysfunctional Uterine Hemorrhage (Hemorrhagia uterina dysfunctionalis). RODOLFO PERCOWSKI. *Rev. med. Rosario* 1945, 38:363.

The absolute frequency of dysfunctional uterine hemorrhage is difficult to evaluate since many patients are not hospitalized, but it is variously given as from 0.8 to 7 per cent. More than 50 per cent of the cases occur in the premenopause (40 to 50 years of age) 20 per cent in puberty and adolescence and from 3 to 35 per cent during sexual life. The etio-pathogenesis must be considered separately for the anovular or monophasic hemorrhage and for the ovular or biphasic hemorrhage. For the first, especially the hyperplastic variety there is a rather clear and well established concept of the determining causes (hypophysis-ovary-endometrium complex) although the ultimate mechanism through which the hemorrhage is produced has not yet been cleared up. For the second which has recently been described the causes are still obscure. It may be stated that the first must be considered as an endometriopathy

of ovarian origin either primary or secondary to hormonal changes (primarily antehypophyseal), in which the degree of sensitivity of the endometrium to the ovarian hormones also plays its part. This sensitivity depends upon whether the hemorrhage results from an atrophic or a frankly hyperplastic estrogenic endometrium.

In anovular hemorrhage the ovary presents some times a single large cystic follicle the layer of granular cells is well preserved and in some cases there is a living ovule. More frequently there are numerous small follicular cysts. The corpus luteum is usually absent. In ovular hemorrhage the ovarian condition has practically not been evaluated and it can only be stated that among 11 patients studied there were 2 in which the corpus luteum was reduced and the cells were loaded with fat.

The histopathology of the endometrium in dysfunctional uterine hemorrhage is particularly interesting. On the basis of extensive studies the endometrium has been classified into estrogenic or proliferative, progestational or secretory and mixed. The statistics of 10 authors who reported on 921 cases show that the distribution of the three types was 74 per cent for the first, 22 per cent for the second and 4 per cent for the third. The authors' 31 personal cases give a similar proportion.

Age has a certain relationship to the incidence of the three types. Above 40 the estrogenic type and above all the hyperplastic type is very frequent, below 40 the progestational type is frequent. This was confirmed in the author's series. In puberty the hyperplastic type is common. There is also a certain relationship between the type of hemorrhage and the histologic type of the endometrium: metrorrhagia is more frequent in the estrogenic endometrium while menorrhagia is usually associated with the progestational or mixed endometrium. Each of these basic types is subdivided into more or less important subtypes.

The histopathology of the endometrium is of great importance in the orientation and control of the hormonal treatment of dysfunctional uterine hemorrhage. It is especially important for the decision as to when the treatment should be stopped after a final curative effect is obtained which is determined by the spontaneous production of an endometrium with a terminal secretory phase. For this purpose it is best to obtain endometrial material by curettage and aspiration. The study of vaginal smears provides additional data and although in adolescents and virgins they cannot replace endometrial biopsy, they help in the orientation of treatment.

Only 5 fatalities from dysfunctional uterine hemorrhage have been reported in the 2 patients who were studied histologically the endometrium was atrophic.

Despite the severity of the metrorrhagia and the presence of blood clots the hemorrhage is nearly always painless. It is often preceded by periods of amenorrhea of from 5 to 8 weeks giving rise to the

clinical variety called the postabortive type. The menstrual history and a negative general examination the absence of organic pelvic lesions or the presence of lesions which do not justify the hemorrhage, and the finding of secondary anemia suggest the diagnosis of dysfunctional uterine hemorrhage. Confirmation is provided by curettage and histopathologic examination of the material recovered. In some cases it will be necessary to take recourse to hysterosalpingocontrastography. At present hormone determinations are insufficient and give discordant results. Basal metabolism determination is useful.

Spontaneous cure is possible especially in puberty or adolescence in which it occurs in from 30 to 80 per cent of the cases. During sexual life there is a possibility of spontaneous ovulation followed by pregnancy and definitive anterior readjustment in the premenopause there is a possibility of extinction of the ovarian function with final amenorrhea.

A table summarizing the therapeutic orientation advisable in accordance with the genital age of the patient is appended. RICHARD KURZ, M.D.

#### Prolapse of the Vaginal Parietes and of the Uterus.

*Etiology, Pathogenesis, and Treatment with the Report of Cases from the Obstetrical Clinic of the University of Turin (Il prollasso delle pareti vaginali e dell'utero. Etiologia, patogenesi e cura con contributo casistico dal materiale della Clinica Ostetrica dell'Univ. di Torino). TIZIO NOBILIZ, Ginecologia Tor., 1948 14, 49.*

The occurrence of prolapse of the uterus in children and virgins is usually due to constitutional disorders e.g. the case reported by Cappellani in which rachitis was the etiological factor. In older people this condition is found among women who have borne children therefore the etiological factor must be found in the anatomical changes which are brought about by labor.

A meticulous anatomical description of the uterus and its adnexa is given and it is believed that the pelvic diaphragm and the urogenital trigone are the important structures that support the uterus the muscles being only secondary.

The author agrees with Gaspari and Morra that, during parturition these structures hypertrophy and become hyperplastic and edematous. This softens and weakens the pelvic diaphragm muscles and perineal fascia and causes a diastasis of the levator ani muscle, 1 to 4 cm. in width. As a result of these changes cicatricial adhesions with the surrounding tissues develop in the posterior wall and cause a shortening of the perineum with destruction of the superficial aponeurosis almost total disappearance of the perineal fascia and atrophy of the transversus muscle. Histological studies of these tissues in women with prolapse show regressive changes of the muscles i.e. granular degeneration of the contractile substance with partial or complete disappearance of the neurofibrillae and at times also fatty degeneration.



The author reports 48 cases which were followed for a period of 3 to 10 years. The ages of the patients varied between 26 and 68 years, and all had (1 to 10) children. In his endeavor to explain the presence of prolapse in young as well as older people in uniparae as well as in multiparae the author agrees with Della Chiaie that the first clinical manifestation of the altered statics of the pelvic organs is to be found in the descent of the anterior vaginal wall and along with it, of the bladder. Because of its proximity to the genital hiatus the bladder will be found relaxed in all women who have borne children, the degree of relaxation depending on the number of children born, the presence of perineal lacerations and the age of the patient. Concomitant with the relaxation of the bladder there is a descent of the anterior vaginal wall first, and later of the uterus which will stretch and ultimately destroy the tonicity of the uterine ligaments. From then on the uterus will continue its downward descent because of its own gravity.

Other factors leading to prolapse of the uterus are minute perineal lacerations not apparent at the time of delivery, a lacerated perineum not repaired, and if repaired, not well healed, and endoabdominal pressure on this locus minoris resistentiae caused by prolonged standing. When lacerations of the perineum are not the cause of the prolapse constitutional muscular weakness must be considered as the etiological factor.

The mechanism of the prolapse is described by the author as follows. The abdominal viscera normally exert pressure on the posterior faces of the normally anteflexed uterus. Pressure on the uterine neck is counterbalanced by the round ligaments. The uterine body rests on the bladder, the vesicovaginal fascia, the pubococcygeal part of the levator ani primarily and on the perineal muscles secondarily. Any unnatural strain which causes a contraction of the diaphragm, abdominal muscles and pelvic diaphragm causes also a contraction of the pubococcygeus muscle. With the contraction of the latter there is a reduction in the fissure formed by the pelvic

diaphragm. In the presence of perineal lacerations there is a lack of support of the neck of the uterus, and the uterus assumes an intermedial or a retroflexed position. The intra-abdominal pressure is now exerted on the anterior uterine faces and the neck of the uterus "threads" so to speak, the genital hiatus. Lack of support causes a pull on the ligaments which, in time lose all resistance and lengthen. From then on the uterine descent becomes progressive unless the condition is corrected surgically. The author advocates the operation of Pritaloma which gives the best anatomical results and does not alter the genital and sexual functions of the patient.

JOSEPH M. A. PAPER, M.D.

Gynecologic Surgery in the Elderly with Special Reference to Risks and Results. FREDERIC D. ZEAMAN and ARTHUR M. DAVID. *Am J Obst* 1948, 56 449.

The increasing numbers of elderly women presenting a variety of gynecologic disorders bring new responsibilities to the gynecologist and to the internist.

This study of 302 cases of women over 60 years of age who were subjected to 217 surgical procedures with only 3 deaths indicates that the range of surgery may be extended for this age group.

Careful preoperative studies of these patients by the team of gynecologist and internist sharply limited the operative risk. These elderly women presented a variety of systemic conditions associated with the local lesions. The implications of hypertension, arteriosclerotic heart disease, anemia, diabetes and malnutrition are discussed in relation to determination of the surgical risk.

Modern methods of anesthesia, the liberal use of whole blood transfusions, early rising and the use of chemotherapy and antibiotics prevented or modified complications in the postoperative period.

Careful evaluation of the functional capacity of older individuals will eliminate false emphasis on chronological age and thus point the way to successful therapy.

JOHN R. WOLFE, M.D.

# OBSTETRICS

## PREGNANCY AND ITS COMPLICATIONS

**Pregnancy Test.** CARLOS GALLI MAININI. *J Am M Ass* 1948 135 121

The author's studies indicate that gonadotropic stimulation in the male batrachia has a direct effect on the testicle in which its targets are the interstitial cells the spermatozoa and the Sertoli cells. The presence of spermatozoa in the batrachian urine (migration to the bladder) is indirect proof that the injected substances have acted on the Sertoli cells. The reaction develops quickly. It is specific for some gonadotropins and the response is slightly different when chorionic, serous or pituitary gonadotropins are injected. The Sertoli cells react quickly to gonadotropins.

The phenomenon of detachment and migration of the spermatozoa to the urinary bladder has a practical application in the diagnosis of human pregnancy. The presence of spermatozoa in a drop of toad's urine a few hours after the subcutaneous injection of 10 c.c. of urine from a pregnant woman indicates a positive result. Accumulated data in pregnancy tests in 2 661 cases showed correct results in from 98 to 100 per cent of the cases and an exact negative response in 100 per cent of 1 166 cases in which control tests were made with urine from non-pregnant subjects. This pregnancy test has the advantages of specificity simplicity speed of reaction clear end point, and economy (the same toad can be used again after an interval of a week).

A modified technique of this test has proved to be useful for quantitative gonadotropic determinations.

ROBERT TURNELL, M D

**A Further Follow Up Study of Eclampsia.** LEON C. CREWELL, WILLARD H. SOMERS, and FELIX H. VAWX. *Am. J. Obst.*, 1948, 56 409.

In the whole experience of the Margaret Hague Memorial Hospital, Jersey City New Jersey through 1945 there have been 245 cases of convulsive and 3 cases of nonconvulsive eclampsia, making an incidence of 0.3 per cent. The immediate maternal mortality was 10 per cent and the fetal loss 33 per cent.

All but 2 of the survivors were followed up for at least a year or until death. All but 8 were re-examined in 1946. In 1940 141 of these patients were seen, and all but 5 of these were rechecked in 1946.

There were 12 late deaths 6 of which were associated with cardiovascular renal conditions. The late annual death rate in the immediate survivors of eclampsia was  $2\frac{1}{4}$  times the expected death rate.

The incidence of hypertension was 15 per cent. An additional 7 per cent of the patients had elevations of either the systolic or the diastolic pressures alone. There was no increase in the incidence of hypertension in a 6 year interval among the group checked in 1940 and rechecked in 1946.

The incidence of hypertension in the eclampsics of the last 6 years was found to be less than half of that in the earlier group. This reduced incidence may have resulted from a more radical management of pre-eclampsia.

In 226 pregnancies subsequent to eclampsia the recurrence rate of toxemia in the pregnancies carried to the period of viability was 34 per cent. The gross fetal loss was 20.3 per cent.

Although one cannot make a certain prognosis in individual patients it is possible to assess the probability of recurrence of toxemia if one has certain data concerning the eclamptic pregnancy. The most significant factors bearing upon the prognosis are (1) the initial systolic blood pressure at the first visit and before the onset of toxemia (2) the severity of hypertension (3) the duration of the toxemia (4) the time required postpartum for the blood pressure and urine to return to normal and (5) the ratio of the patients' weight to his height.

JOHN R. WOLFE, M D

**Heart Disease and Pregnancy.** P. R. C. EVANS. *Guy's Hosp Rep Lond* 1948, 96 194.

The author reviews and studies the case reports on pregnant patients suffering from heart disease who were admitted to Guy's Hospital London between 1938 and 1946. There were 90 patients representing 100 pregnancies. The patients were classified according to the New York Heart Association standards. The type of heart disease was divided into congenital thyrotoxic, syphilitic, and rheumatic.

The article consists of a series of tables in which the author summarizes the study.

GEORGE B. BRADBURN, M D

**Diabetes in Pregnancy.** PAUL M. RIKK and ROBERT M. FAWCETT. *Am J Obst* 1948, 56 484.

This study is presented to enumerate the complicating factors of diabetes in pregnancy as they occur at the Elizabeth Steel Magee Hospital Pittsburgh Pennsylvania. The report is based on a 10 year period extending through June of 1946. Among a total of 31 544 deliveries there were 55 cases of diabetes complicating pregnancy. In one-fourth of the cases the diabetes was first discovered during the pregnancy. The average age of the pregnant diabetic patients was 8 years greater than the average age of all the pregnant patients at the hospital. There were twice as many white diabetic pregnant patients as negro.

Most of the pregnant patients with diabetes had excessive weight gain probably due to water retention. One third of these patients had some type of toxemia. One patient developed eclampsia. Sixty-one per cent of all these diabetics in whom the disease was recognized first during pregnancy had some degree of toxemia.

The average duration of pregnancy was less than full term, although in the majority of cases it was of over 8 months duration. Two-thirds of the patients were delivered vaginally. The weight of the full term infants was above normal. The weight of the 8-month infants approached the normal average weight of full-term infants.

The overall fetal mortality was 28.8 per cent. If all deaths up to the seventh month are excluded the corrected mortality is lowered by 10 per cent. There were no fetal deaths among the deliveries by cesarean section. There were 2 maternal deaths, both of which occurred in toxic cases.

Diabetes alone is no indication for therapeutic abortion. All pregnant diabetics should be closely followed up by both the medical and obstetric services in order that the best form of treatment and the most suitable type of delivery can be chosen.

JOHN R. WOLFF, M.D.

**The Necessity for Treatment of Pregnant Syphilitic Women During Every Pregnancy.** MARY STEWART GOODWIN and MARY STREETEY. *Rev. Am J Syph.*, 1943, 3: 400.

The authors report on 363 women with varying types of syphilitic infection who previously had received metal chemotherapy. These women were observed through 370 subsequent pregnancies in which further antisyphilitic treatment was purposely omitted. Twenty-two women, all of whom were originally treated with penicillin for early syphilis, were observed through 46 subsequent pregnancies in which further antisyphilitic treatment was purposely omitted. Of the 596 infants born of these pregnancies during which the mothers were so treated, 549 (92 per cent) were born alive. Twenty of the 48 infants who were stillborn or miscarried were examined at autopsy. Evidence of syphilis in the fetus was found in none. Of the 549 infants born alive, 88 per cent have been carefully followed up for more than 2 months and more than 70 per cent for more than a year. All of the children followed up were normal and nonsyphilitic.

These data indicate that it is not necessary to administer antisyphilitic treatment to a syphilitic woman during every pregnancy and that there is a high degree of probability that the infant will be normal if maternal treatment is withheld (a) regardless of the stage and duration of the syphilitic infection in the mother at the time of the original diagnosis and treatment and (b) regardless of the interval between the previous treatment and the pregnancy in which it is contemplated that further treatment be omitted. However the mother should previously have received 4.0 gm. or more of arsenphenamine (or its arsenical equivalent) together with concomitant bismuth or 2.4 or more million units of penicillin (given for early syphilis and this probably holds good for a maternal diagnosis of late latent syphilis as well) and this previous treatment should have been administered during a previous pregnancy or during a nonpregnant interval. Also

the mother should show no clinical signs of active syphilitic infection, and should be seronegative or if still seropositive should have a low titer only (1 to 8 dilution units).

Until further information accumulates, a syphilitic woman should be further treated in any pregnancy in which she herself shows clinical evidence of active syphilitic infection or in which, in the absence of such clinical evidence, she herself has a positive serologic blood test for syphilis in a quantitative titer of 16 or more dilution units.

CHARLES BARON, M.D.

## LABOR AND ITS COMPLICATIONS

**The Practical Application of X-Ray Pelviography to Clinical Obstetrics.** DAVID N. DANKFORTH. *Q. Bull. Northwest. Univ. M. School* 1943, 31: 3.

The author reviews the subject of x-ray pelviography to create a fuller appreciation of its purpose and possibilities on the one hand and on the other hand to discuss its limitations. The article is based on the work of Caldwell and Moloy, but it is not intended to ignore the work of Thoms, Mengert, Steele and Javert, Moir and others.

He first discusses the pelvic variations which are of obstetrical importance. The Caldwell-Moloy classification clarifies these by pointing out the variations in the following pelvic features:

Inlet shape

Width of the fore pelvis

Ratio of the widest transverse to the longest anteroposterior diameter

Ratio of the anterior sagittal to the posterior sagittal diameter

Splay of the side walls

Prominence of the spines

Height of the symphysis

Transverse diameter of the outlet

Width of the subpubic arch

Curvature and inclination of the sacrum

The four parent groups of Caldwell and Moloy are discussed and differentiated, namely gynecoid, android, anthropoid and flat, and it is pointed out that rarely is a true type of pelvis encountered but rather that most of the pelves are mixed types which show not only variations in the pelvic type combinations but also considerable variation in size.

The author next discusses the roentgenographic demonstration of the important pelvic features and points out that any technic which is truly satisfactory should demonstrate all of the above outlined pelvic features and their interrelationship. In addition, it would be ideal if it allowed measurement of the biparietal diameter of the head. The most satisfactory method for determining this latter measurement is by the Caldwell-Moloy method of viewing the stereoroentgenogram with the precision stereoscope. This instrument is not at present available. The method used by the author is a combination of those of Caldwell and Thoms, Steele and Javert. The measurements are

1 Standing lateral at 36 inches with a 10 cm rod between the patient's buttocks

2 The Thoms inlet view taken with the patient in the Thoms semirecumbent position.

3 A subpubic arch film with the patient supine and the tube directed at a 45 degree angle toward the symphysis as the target.

In addition a flat film of the abdomen is valuable in determining fetal age and abnormalities.

The purpose and practical use of x-ray pelvigraphy is to determine cephalopelvic disproportion and to prognosticate the mechanism of labor. Cephalopelvic disproportion cannot be determined unless the measurement of the fetal head can be taken. In the absence of a Moley precision stereoscope these measurements are impractical. An inexact but useful subterfuge is used by the author to determine inlet proportion. The effective diameter of the inlet is the diameter of the largest circle that would engage in the inlet. This diameter in primiparas should be 5 cm. larger than the biparietal diameter of the head. In an average sized baby as determined by clinical examination the biparietal diameter is from 8.5 to 9 cm. therefore the effective diameter of the inlet must be at least 10.5 cm. In multiparas the difference in diameter is usually 1 cm. instead of 1.5 cm.

The author discusses at length the prognostication of the mechanism and states that for practical purposes full utilization of available space in the pelvis must be made. To interpret the mechanism one must regard two dicta as axiomatic (1) the biparietal diameter is considered the narrowest diameter of the head, and (2) the occiput, generally tends to rotate to the widest point of the pelvis. In this prognosticating one must take into account the general shape of the inlet, the width of the fore pelvis the ischial spine the inclination of the sacrum the nature of the subpubic arch and the transverse diameter of the outlet.

The interpretation of these factors is important especially in delivering with forceps from the mid pelvic position so that the narrowest fetal head diameter may be brought through the narrowest pelvic diameter. Some of the common mechanisms are reviewed namely

Positions (a) occipitoanterior midpelvic arrest (b) occipitoposterior, midpelvic arrest and (c) occipitotransverse midpelvic arrest

The author's excellent article is a timely review and in addition voices an unwritten plea for the more extensive and intelligent use of x-ray pelvigraphy

BYRON F. HAZARET M.D.

**Pethidine in Labor** DONALD BEATON *Edinburgh M J.* 1948 55:354.

The apparent effect of pethidine on uterine contractions is to decrease both frequency and intensity. This appeared to happen in 60 patients (66 per cent) but it could not have interfered with the function of the uterus since in this series labor was not prolonged. Pethidine does not appear to shorten labor

It has no serious ill effects on the mother or child except that the incidence of postpartum hemorrhage appears to be increased.

The drug has been used with great advantage to the mothers particularly those who were nervous and excited. There appears to be safety in large dosage no matter when the drug is given in the first stage of labor.

CHARLES BARON M.D.

**Sulfadiazine and Penicillin Prophylaxis in Cesarean Section** R. GORDON DOUGLAS and ROBERT LAMDESMAN *Am. J. Obs.* 1948 56:432

The problems involved in the proper management of patients with prolonged labor constitute a major challenge to the obstetrician. Cesarean section appears in some instances to offer the best solution, but at times it has not been performed because of the probability of serious maternal morbidity. A study is in progress at the New York Lying In Hospital, New York City to determine the prophylactic value of the administration of sulfadiazine and penicillin in prolonged labor and other complications in which infection may be anticipated.

The results so far indicate that the combined prophylactic use of sulfadiazine and penicillin in cesarean sections has contributed to a reduction in the severity of intrauterine wound and peritoneal infections. With early prophylactic drug therapy a longer trial of labor may be continued without danger. The control of infection by these agents broadens the safe employment of transperitoneal section and reduces the need for extraperitoneal section and cesarean hysterectomy. These drugs may be administered without serious toxic reactions during labor and the puerperium. Urinary tract infections associated with prolonged labor and cesarean section have been drastically reduced. The prophylactic therapy has decreased infantile mortality.

Penicillin and sulfadiazine may act together in increasing the total bacteriostatic activity against a single infecting agent their effectiveness together covers a wide range of bacteria.

JOHN R. WOLFE M.D.

**A Short or Shortened Umbilical Cord as an Indication for Cesarean Section and Other Obstetrical Operations** (Über die durch zu kurze oder verkürzte Nabelschnur bedingte Indikation zum Kaiserschnitt und zu anderen geburtshilflichen operationen) FRANK KURHBACHER. *Geburtsh. & Frauenh.* 1948, 8: 372

The author considers the problem of a short or shortened umbilical cord or both as an indication in itself for operative delivery. He admits the occurrence is a rare one.

Four cases are presented. All of the parturients had pelvis smaller than normal. The infants weighed from 2 000 to 3 600 gm. In each instance but one the cord was considered to be somewhat short (from 40 to 43 cm.) and was wrapped around the neck at least once. Two women were delivered by cesarean section 1 woman by internal podalic

version and extraction and the last by high forceps. There was no cephalic molding of the babies born by cesarean section. All 4 children were delivered alive.

The diagnosis is of necessity difficult. However six signs are listed (1) a funic souffle (2) a "dent" in the uterine wall at the placental site, (3) irregular and severe labor pains, (4) arduous descent of the fetal head, (5) upward withdrawal of the head at the decrement of the uterine contraction, and (6) fetal heart sounds audible on the "rounded" rather than the "flattened" side of the uterus (when the cord is wrapped around the fetus because the back of the child is flattened against the placenta).

The author concludes that with nondescent of the head with or without evidence of fetal distress a cord of insufficient length to permit spontaneous delivery should be considered. Operative delivery is indicated when such a situation is strongly suspected.

WARREN R. LAXO, M.D.

### PUERPERIUM AND ITS COMPLICATIONS

**Histologic and Clinical Findings in Late Puerperal Bleeding (Histologische und klinische Befunde bei Spätwochenbettblutungen)** HANS LINSBURG  
*Geburtsh. & Frauenk.*, 1943, 8, 352.

Bleeding occurring late in the puerperium offers many possibilities as to etiology. Older textbooks mention retained placental tissue, decidua or fetal membranes, and endometritis as the most frequent findings in this type of bleeding, but the author after reviewing the writings of others and studying 90 cases of late puerperal bleeding observed in the Women's Clinic at the University in Hamburg, Eppendorf, does not find this to be true.

The author divides his patients into two groups: the first group consists of 41 patients treated in the period from 1922 to 1940, the second, of 49 patients treated in the period from 1940 to 1947.

In the first group macroscopic evidence of placental tissue was found only 4 times (9.8 per cent) and microscopic evidence of placental tissue in the form of a fibrinous polyp was found 5 times (12.2 per cent). Other findings were retained decidua, hyalinization of the blood vessels, endometritis, fibrinous blood clots, irregular proliferation of the endometrium, endometrial hyperplasia, and irregular shedding of the endometrium from a defective corpus luteum. The latter three were considered of sufficient importance to be responsible for the bleeding in 15 instances (37 per cent).

In the second group placental tissue of sufficient size to be recognized grossly was obtained in 13 cases (27 per cent). In 21 cases (43 per cent) it was recognized microscopically. Other causes for bleeding were retained decidua and endometrial hyperplasia, the latter comprising 10.2 per cent. Bleeding from placental fragments occurred usually in the first 4 weeks postpartum.

With late puerperal bleeding, therefore one must consider not only retention of the product of conception but also the endometrium itself.

be hyperplastic or incompletely formed in the proliferative or secretory phase from imperfect follicle or corpus luteum formation. Curettage with histologic examination of the material obtained is necessary to determine the exact cause for bleeding. More over, curettage has therapeutic value.

WARREN R. LAXO, M.D.

### NEWBORN

**Postpartum Necrosis of the Pituitary** T. N. A. JEFFCOATE. *Irish J. M. Sc.* 1948, Ser. 6, 256.

The author is in total agreement with Sheehan as regards the etiology and clinical features of postpartum necrosis of the anterior lobe of the pituitary gland. He also wishes to emphasize that patients with this syndrome in contradistinction to Simmonds' belief do not show evidence of cachexia until the terminal stages of the process. He believes that Sheehan's estimate of the frequency of the syndrome is slightly high and that the disease is comparatively rare. The rest of the article is concerned with treatment, which is believed to be more difficult than diagnosis. At present the treatment consists of substitution therapy with gonadotropin, corticotropin, thyrotropin, deoxycorticosterone, estrogens and androgens.

**Gonadotropins.** The author has not had the opportunity of thoroughly testing the effect of follicle stimulating hormone and luteinizing hormone in this syndrome but he believes that gonadotropin therapy offers more chance of restoring ovarian function in these cases than in any other type of ovarian failure or amenorrhea.

**Corticotropin.** In general the results are disappointing but some patients claim they have a sense of improved well being.

**Thyrotropin.** Preparations of the drug are difficult to obtain and their potency is also doubtful. Thyrotropin has been used by itself with no effect.

**Deoxycorticosterone** has been used without producing any improvement. It is indicated only in cases with a significant electrolyte disturbance.

**Estrogens.** With adequate dosages pronounced effects are noted. The vulva, vagina, and uterus lose their senile characteristics and assume those of a woman in the active phase of her reproductive life. Intermittent therapy will produce estrogen withdrawal bleeding. The patients have more energy and gain weight.

gency The author also states that tissue transplants must be considered in therapy but at the present time there has been little success with this procedure The emergency treatment of a patient in crisis consists wholly of intravenous glucose therapy, but vitamins R and C and a high protein and sodium diet are also indicated.

J ROBERT WILLSON M.D

### MISCELLANEOUS

**Pregnancies after Untreated Sterility of Long Standing** (Schwangerschaften nach langjähriger unbehandelter Kinderlosigkeit) KARL JOHANN ANSCHUTZ, *Geburtsh. & Frauenh.* 1947 7 19

The author discusses in detail a series of 30 cases in which gravidity occurred after many years of sterility without any treatment of either of the partners.

He stresses the psychogenic factors in the pathogenesis of functional sterility Especially domestic conflicts with parents or in laws marital difficulties fatigue and worry in business and professional life and financial trouble due to unemployment seem to be causative factors

When it was possible to straighten out these conditions pregnancy occurred frequently without any treatment.

WERNER BL. SCHWARTZ, M.D

**Demonstration of Lysozyme in the Amniotic Fluid with Reference to the Bactericidal Power of the Amniotic Fluid** (Dimostrazione del lisozima nel liquido amniotico. A proposito del potere battericida del liquido amniotico) G. VECCHIETTI *Quadr. clin. ostet. gin.* 1948, 3 233.

The majority of authors have denied the existence of a lysozyme in the amniotic fluid Vecchietti extracted amniotic fluid by transabdominal puncture from the amniotic sac in 10 pregnant women and tested these samples by the usual method of graduated dilutions for the usual test organism (*Micrococcus lysodeikticus*) which is of course highly lysozyme-sensitive Concurrent identical tests were run against the subject's blood serum

By this method the author finds that lysozyme is present in the amniotic fluid of normal healthy women in the ninth month of pregnancy about one-fourth the amount present in the same subject's blood serum. It is believed that the bactericidal action of the amniotic fluid explains why the amniotic cavity so seldom becomes contaminated from the blood stream of the mother who has bacteria in her blood stream and why infection does not develop intra-amniotically in every case in which the sac has been ruptured.

It is assumed that this bactericidal power of the amniotic fluid also extends to other bacteria many of them pathogenic.

JOHN W. BRECKEN, M.D

**Obstetrical Evaluation of the Pubic Arch** W. I. C. MORRIS, *Lancet* Lond., 1948 2 130.

The author presents a clinical method of estimating the availability of the pubic arch for ob-

stetrical delivery A circular metal disc 8 cm. in diameter is used as the measuring device. A metal strip with a centimeter scale is attached to the perimeter of this circle Measurements are made with the patient in the lateral prone position with one leg drawn up The disc is pressed between the ischial tuberosities so that the pubic margin fits snugly The distance between the margin of the disc and the under surface of the pubic arch is measured in centimeters

The author interprets any distance greater than 1 cm. as an indication of narrowing of the arch He suggests that the method is almost as accurate as roentgenological measurement however when narrowing is indicated further study by means of the x rays is indicated The method is apparently more accurate than many others in estimating the angle of the arch and certainly serves to emphasize the importance of knowing the type of outlet with which one has to deal during delivery

GEORGE B. BRADBURN M.D

**Microscopic Observations of the Placental Barrier in Transplacental Erythrocytotoxic Anemia (Erythroblastosis Fetalis) and in Normal Pregnancy** B. S. KLING, *Am. J. Obst.*, 1948, 56 226

Microscopic examination of the placenta in 15 cases of erythroblastosis fetalis showed numerous breaks in the barrier associated with hemorrhage from the fetal circulation into the maternal intervillous spaces In areas of very recent hemorrhage nucleated red blood cells of the fetus were observed in the regional intervillous spaces. Regional to the areas of vascular occlusion, the overlying epithelium showed degenerative or necrotic change and in places there was erosion associated with hemorrhage from the fetal circulation into the regional intervillous spaces. Coincidentally access of the maternal blood to the fetal circulation was afforded.

Microscopic examination of the placenta in the last half of normal pregnancy showed numerous breaks in the barrier of the same type as observed in the cases of erythroblastosis fetalis.

Since it is now known that the erythroblastosis in the disease is a secondary manifestation the designation erythroblastosis fetalis is no longer justified Furthermore it has been found that destruction of the incompatible fetal red blood cells in the disease occurs in part by phagocytosis The term congenital hemolytic anemia therefore is not entirely accurate and transplacental erythrocytotoxic anemia is suggested as a better name for the disease

JOHN R. WOLFE M.D

**Contribution to the Study of Ectopic Chorionepithelioma. Chorionepithelioma Situated in the Liver** (Contributo allo studio del corionepitelioma ectopico. Corionepitelioma a sede epatica) ARMANDO FASANELLI *Arch. ostet. gin.* 1947 52 340.

One of the most interesting aspects of the study of chorionepithelioma is that which deals with the ectopic localization of the tumor

The study of these localizations, which may involve various organs without even involving the uterus or uterine tubes broadens our knowledge of the problems concerning the nature and the pathogenesis of chorioepithelioma. This particular tumor loses its restricted significance as a tumor of one organ, the uterus, and acquires the more extensive significance of a tumor that might involve widely separated organs.

These tumors occur most frequently in connection with the pregnant state, completed or interrupted recent or remote, although they may occur independent of the pregnant state as in case of chorioepithelioma of teratogenous origin.

The most common sites of the ectopic localizations of chorioepithelioma are the uterus, vagina, intestine, lung, bladder, broad ligament, and rectovaginal wall. A comparatively rare ectopic localization is the liver. The author could collect only 5 such cases in the literature, and to these he adds a sixth case which came under his observation giving the complete clinical record of the patient and autopsy findings.

The case reported occurred in a married woman 37 years of age who had always been healthy until 5 months before entry into the hospital. Following the delivery of her second child, which was spontaneous and normal in every way she had experienced intermittent low grade fever with chills sensations. The fever was accompanied by a severe type of continuous pain in the right hypochondrium, the pain radiating to the back and the right shoulder and becoming accentuated when the patient lay on her right side. She developed anorexia and general weakness, both of which gradually increased in severity. She entered the hospital in a moribund condition and during the 24 hours prior to her death, she ran an undulating type of fever and developed severe pain in all parts of her abdomen. She vomited several times and was very dyspneic until death.

Physical examination revealed a moribund patient with signs of right pleurisy. Her abdomen presented a large tumor firm in character and extending from the right hypochondrium to the right iliac crest. The tumor proved to be painful on palpation.

Autopsy revealed a right fibrinous pleurisy. The abdominal cavity contained an abundance of bloody fluid. The liver was noticeably enlarged and weighed 410 gm. It extended downward and transversely to the umbilicus. The right lobe of the liver presented a reddish tumor mass the size of a large apple. The surface of the tumor appeared nodular and irregular. The consistency of the tumor was less firm than that of the surrounding liver tissue. The tumor margins were ill defined, the capsule was perforated in several places. Grossly on section the tumor presented a nodular formation with the appearance

of a bloody sponge, the size of the nodules ranging from the size of a chick-pea to that of a hazelnut.

The uterus was of normal appearance and consistency, but was slightly enlarged. The mucosa was swollen and grayish white in color. The cavity contained a whitish fluid. The body of the uterus and the vagina were normal. Both ovaries contained multilocular cysts. The right kidney contained a calculus.

The anatomopathological diagnosis was that of hemoperitonium from rupture of a primary tumor of the liver, cardiac decompensation, right fibrinous pleurisy, right renal calculus, and cystic degeneration of both ovaries.

Histological section of the liver showed the tumor nodules to consist of a central and a peripheral zone. The central zone was composed of layers of fibrin, in which there were red blood cells, some of which were of normal appearance and others in various stages of degeneration. Passing from the central zone to the periphery were characteristic neoplastic cells, some in groups and some isolated. These cells were of two types. One type was in the shape of irregularly polygonal cells with clear cytoplasm and small basic-staining oval nuclei. These cells tended to form a membrane. The other type of cells were syncytial cells presenting numerous stages of fusion characteristic of tumor cells. The cell protoplasm was granulated and vacuolated and intensely basophilic. These cells had no characteristics which revealed their origin.

Histological section of the ovaries showed the picture of true corpus luteum cysts.

Histological section of the uterus showed a typical decidua reaction but there were no tumor cells present. Sections of the uterine tubes were normal.

Failure to find evidence of a primary tumor in the uterus, ovaries and tubes shows that the chorioepithelioma of the liver in this case was not metastatic.

There is no structural evidence in the tumor to show that it was of teratogenous origin.

The author believes that this chorioepithelioma of the liver developed from the trophoblastic elements which were progressively dispersed from the decidua uterina. Invading the vessels of the myometrium, these cells passed along through the pulmonary circulation without invading the lungs and came finally to lie in the liver where they developed into the tumor mass. During normal placentation elements of ectodermal origin infiltrate the peripheral myometrium. During decidua reactions in the uterus emboli of trophoblastic elements have been demonstrated in the maternal lungs and liver. In this case the pathological symptoms referable to the liver developed following delivery and progressed rapidly to a fatal termination within 5 months.

BLACKWELL MARKHAM, M.D.

# GENITOURINARY SURGERY

## ADRENAL, KIDNEY AND URETER

**Urokiomography (Urokiomografia)** ENRIQUE PEREZ CASTRO *Arch. esp. urol.* 1948 4 275

This is a treatise on the many advantages of urokiomography which Castro believes is more valuable than pyelographic studies, serial roentgenography and roentgenographic moving pictures.

Kymography has been applied to cardiac studies and it is thought its advantages here equal those of the electrocardiograph. It is a field little explored at present.

The recording of a moving body in the urogenital system is of inestimable value and urokiomography permits not only this but gives a detailed study of kidney dynamics, particularly of pelvic peristalsis and the normal and abnormal functioning of the calices and ureters. Not only are accessory ureters with or without double kidneys observed, but the functioning of each unit can be determined.

The article has many contrasting illustrations pointing out the advantages of each method of objective study.

STEVEN A. ZIEGLER, M.D.

**Experimental Contribution to the Study of the Behavior of the Renal Lymphatic System Following Partial Subtotal or Total Block of the Lymph Flow and Its Significance in the Pathogenesis of Renal Infections** (Contributo sperimentale allo studio del comportamento del sistema linfatico renale in seguito a blocchi parziali, subtotali e totali della corrente linfatica e suo significato nella patogenesi delle infezioni renali) VITTORIO STAUDACHER DALL'ARTE AND BRUNO AMBIZANI. *Arch. ital. urol.* 1947 22 236

An experimental study on dogs was undertaken by the authors to investigate the possibility of a renal infection through ascending or descending lymphatic paths. The experiments were performed on 12 dogs under general anesthesia. A suspension of Prussian Blue in turpentine oil was used for the injection of the lymphatics. The experiments were divided into 2 groups: (1) injections into the vesical and ureteral lymphatic reticulum, collecting vessels and external, internal and common iliac lymph nodes and (2) similar injections after the preceding creation of a partial or complete block by means of an occlusion of one lymph vessel, ligation of one or a few afferent lymph vessels or ligation of all lymph vessels leading to the clateria chyli.

The experiments showed that no connection exists between the intramural lymphatic reticulum of the ureter and the corresponding renal parenchyma. There are communications between the collecting vessels of the upper segment of the ureter and the kidney but, no matter whether normal physiologic conditions prevail or a stasis is provoked, the lymph maintains a centrifugal direction. In spite of a partial subtotal or total block, the lymph flowing from

the kidney maintains strictly the centrifugal direction.

It follows that the propagation of pathogenic bacteria toward the kidney by the retrograde route from remote foci of infection is unconceivable. An inversion of the lymph flow required for contamination of the kidney through the lymphatic paths can be created experimentally only under exceptional conditions which cannot be duplicated in human pathology.

JOSEPH K. NARAT, M.D.

**The Pathogenesis of Serous Cysts of the Kidney, with a Personal Observation** (Sulla patogenesi delle cisti sierose del rene, con una osservazione personale) P. RIGATTIERI. *Arch. ital. urol.*, 1947 22 157

A 55 year old mother of 8 children who had also had two spontaneous abortions had been suffering from frequency of urination for about a year. About 3 months previously she had begun to suffer with cramplike pains and a sense of heaviness in the left lower part of the abdomen. The examination including a roentgenogram, uncovered the usual findings of a large growth on the left kidney. Nephrectomy brought to light a fetally lobulated left kidney with a serous cyst (size of a child's head) attached rather extensively to its free lateral border and another cyst (size of a hazelnut) protruding halfway above the surface on the anterior aspect of the lower pole. When the kidney was sectioned a still smaller cyst was found just beneath and contiguous to the partially protruding cystic formation.

Histologic examination of all these cavities containing serous fluid disclosed the typical double stratified structure with areas of the inner wall still clothed by endotheliumlike cells. The contents of these cysts was a clear lemon-colored liquid of neutral reaction and with traces of albumin, phosphates and sulphates, but no urea.

The author believes that these cysts were congenital and to be explained on a dysembryoplastic basis (Ruckert, Kampmeier).

JOHN W. BRIDGMAN, M.D.

**Bilharzial Affection of the Ureter** MICHAEL GELFAND *Brit. M. J.* 1948, 1 1228.

The ureter is often affected in urinary bilharziasis. Therefore the purpose of this article is to report on the various lesions found in the ureter in a series of 110 consecutive autopsies on Africans held at the Salisbury Mortuary, Southern Rhodesia.

The literature would appear to stress the obstructive lesions encountered in urinary schistosomiasis. As early as 1919 Fairley drew attention to the tendency of the disease to invade the lower portion of the ureter. He reported that catheterization of such a ureter may reveal a hydronephrosis that has not shown any clinical manifestations. He is one of the early workers to refer to the golf hole appearance



of the ureteric orifice which he not infrequently found involved even in early cases. In another publication Fairley (1919) drew attention to the obstruction occurring in a bilharzial ureter but he also recognized the possibility of a hydronephrosis resulting from obstruction in the bladder wall itself. In his experimental work on infected monkeys he found that the lumen of the lower third of the ureter may show dilatation and the wall considerable thickening. The dilatation results from obstruction due to thickening from the cellular infiltration of the wall in the neighborhood of deposited ova.

Aly Bey Ibrahim (1933) published from Egypt an important article on bilharziasis of the ureter. In it he refers to the very serious complication of stricture of the ureter. Dew (1933) of Egypt infers that the ureter becomes narrowed because of fibrosis and calcification contraction ensuing fairly early in the disease. Hydronephrosis as a result is common. Also from Egypt, Hutchison (1938) refers to an ascending pyelitis and hydronephrosis resulting from stasis of the urine occurring because of obstruction at the lower end of the ureter. Campbell Begg (1944) writing on schistosomiasis in South Africa refers to the occurrence of a tight fibrous stricture of the ureter which is found only in the minority of cases. Kirkaldy Willis (1946) working in East Africa, mentions the possibility of obstruction in the lower ends of the ureters.

The examinations reveal certain interesting points, and if corroborated by others might cause the present day treatment of bilharzial ureteric disease to be reviewed.

While stricture or stenosis of the ureter is encountered at autopsy this finding is very much less common than the author originally expected. He reported a series of 100 consecutive autopsies in patients affected by vesical bilharziasis and found only one stricture but many dilated ureters. In 1 of the 3 cases showing stenosis in this second series hydronephrosis was present. The author does not state that stricture or stenosis is not serious and does not occur in practice nor that cases of hydronephrosis due to it are not found. However such cases are comparatively rare.

Dilatation of the ureter by the disease is far more common than stenosis or stricture. Such dilatation is usually associated with thickening of the wall of the ureter which also becomes elongated and tortuous. This fact is usually well demonstrated roentgenologically. The functions of such a ureter will become impaired peristalsis will be diminished or lost, and hence urine would not be properly propelled toward the bladder. As a result, stasis will follow and with it some degree of hydronephrosis. This may not be the only explanation of hydronephrosis in cases showing only dilatation of the ureters. Another possible explanation for some of these cases may be a reflux of urine up an incompetent ureteric orifice during micturition when the bladder actively contracts. Because of the dilatation produced by the disease the sphincteric function of

the intravesical portion of the ureter is lost or impaired. The hydronephrosis due to such loss of sphincteric function probably explains some of the cases of hydronephrosis seen in prostatic disease (Hughes, 1946).

When the ureter dilates it also lengthens and "unfolds itself." This "unfolding" may cause the ureter in the particular portion affected to assume an S-shaped curve or bend thus simulating stricture. This was seen in one of the 25 cases reported with dilatations of the ureter. The right ureteric orifice protruded about 8 mm. beyond the bladder mucosa. The orifice itself was dilated (6 mm.) The tube could be passed neither from below nor from above and a stricture was held to be responsible for this. However on opening the ureter the intravesical portion was dilated because of disease. Its circumference being 11 mm. as compared with 8 mm. on the opposite side. The intravesical portion of the ureter had elongated and hence its orifice protruded beyond the bladder mucosa the rest of it had become folded, so to speak, upon itself causing an obstruction.

Recently Barlow, of the Southern Rhodesia Government Medical Service was able to demonstrate such a reflux in one ward case. The patient, an African male passed ova of *Schistosoma haematobium* in his urine and an intravenous pyelogram revealed a well marked dilatation of the lower end of the right ureter. Barlow filled the bladder with "uropac" and then instructed the patient to empty his bladder. An x ray film taken before and after micturition revealed that some of the dye had passed up the ureter from the bladder. There was no evidence of a hydronephrosis on the affected side.

A series of 110 consecutive autopsies were performed on African adults found to have bilharzial disease of the bladder.

In 35 cases the ureters were dilated by the disease. Stenosis or stricture of the ureter was found in 3 cases.

Hydronephrosis was found in 3 cases showing dilatation of the ureters and in one of the cases affected by stenosis of the ureter.

Possible explanations for the hydronephrosis in the presence of dilated ureters are advanced.

JOHN L. KIRKPATRICK, M.D.

Ureterocutaneous Transplantation. GIL SCHMIDEL and GEORGE SEWELL. *J U of Calif.*, 94:5, 60:356.

A method of ureterocutaneous transplantation is presented whereby a tubed pedicle is prepared, to enable the terminal segment of the ureter to protrude from the skin and yet remain viable.

Through an oblique skin incision near McBurney's point the muscles are split and the ureter is divided and brought to the surface. A catheter is placed in the ureter, and the wound is closed up to the skin. One of three methods is used in applying skin pedicles. If the abdominal wall is loose as it is likely to be in thin patients, quadrangular skin pedicles are used. Silk is used to close the tube and a steel wire suture is used at the base

The mucosa at the mouth of the ureter is sutured to the skin. If the patient is obese and the skin is taut longitudinal skin pedicles are made bilaterally with parallel incisions.

A third method is to wrap a single longitudinal skin pedicle corkscrew like to form the tube. Following operation the ureteral catheter is fixed in a vertical position with a wire frame.

The procedure described was devised in an attempt to avoid the use of a permanent catheter in the ureter to facilitate gravity drainage of the urine and to avoid stricture formation.

JOSEPH E. MAURER, M.D.

# BLADDER, URETHRA AND PENIS

**Vesical Dysfunction in Paraplegia.** HERBERT S. TALBOT *J. Urol.*, Balt., 1948, 59: 1130.

The major urologic problems encountered in the care of patients with spinal cord injuries arise either directly or indirectly from interference with the normal innervation of the bladder. A prominent exception is the tendency toward urinary lithiasis which is frequently exhibited by patients undergoing long periods of muscular inactivity for any reason, but even this is in these cases notably enhanced by the stagnation and infection resulting from the vesical dysfunction. It is of course well known that vesical function which is normal or clinically indistinguishable from normal is restored spontaneously in a significant proportion of cases of spinal cord injury even though paralysis of the extremities may remain. It is probably true as well that if genuine recovery of bladder function is to occur it will occur relatively early perhaps as soon as spinal shock has passed. However spinal shock is itself a phenomenon of variable duration. Sensory and motor return in the extremities is seen 18 months or more after injury and although visceral return may not be anticipated after so long an interval, it is difficult to find logical justification for establishing an arbitrary time limit beyond which no prospect remains but permanent suprapubic drainage.

The bladder is a reflex organ upon which has been superimposed a number of controls exerted by the higher nervous centers which are largely inhibitory in character, with probably an added factor of co-ordination. The normal bladder manifests a striking capacity to adapt its configuration to changes in the volume of its contents. Detrusor contraction is stimulated by stretch only and is associated with a reciprocal opening of the internal orifice which is independent of central nervous control. Inhibition of micturition is a direct mechanism; facilitation is indirect and is effected by withdrawal of inhibitory barriers to reflex contraction.

The reflex centers for vesical function are located in the second third and fourth sacral segments of the spinal cord. The efferent supply to the detrusor muscle passes through parasympathetic pathways. Interruption of the sympathetic nerves has no effect upon micturition. The afferent fibers pass through

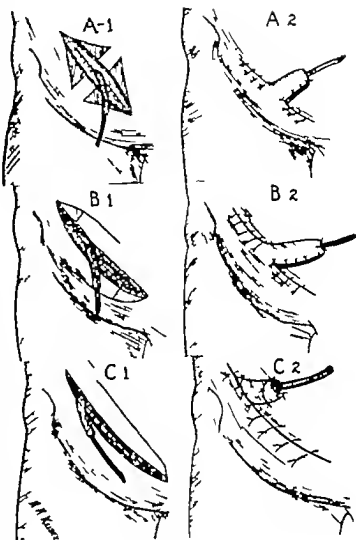


Fig. 1 (Schinagel and Sewell)

both parasympathetic and sympathetic channels some of those in the latter entering the cord as high as the ninth dorsal segment.

Cystometry provides a valuable means for the study of the normal or pathological physiology of the bladder.

The treatment of neurogenic vesical dysfunction after spinal cord injury should not be considered as completed when reflex involuntary voiding has been established. A program of rehabilitation is suggested which in a considerable number of cases will result in urethral voiding little or no residual urine, a useful bladder capacity and a reasonable degree of voluntary control. The methods employed include closure of urinary fistulas, tidal drainage, training of the patient to initiate voiding at suitable intervals and transurethral resection in suitable cases.

JOHN E. KIRKPATRICK, M.D.

**Plesiorontgenotherapy of Bladder Tumors (La plesiorontgenoterapia del tumore vescicale)** PASQUALE BRUGI. *Urologia* 1948 15: 207

The technique of plesiorontgenotherapy used by the author consists of suprapubic opening of the

bladder and exposure of its cavity by the use of Legueu's retractor. The tumor is lifted with Marshall's forceps for vesical tumors and cut with the electric knife at its base. A field-limiting portal, sterilized by boiling and having a diameter of 25 mm. and a surface of 500 sq. mm., is applied to the cut base of the tumor and kept in place by a forceps, and the extremity of the roentgen tube covered by a sterile rubber finger cot is introduced into the portal. If the portal is too small to cover the entire tumor base two or more fields are used successively. The factors for irradiation are distance 5 cm, filter 0.3 mm. of aluminum, kilovolts, 50 surface dose, 8,000 roentgens per minute. After irradiation, the bladder is closed on a Pezzer sound and the abdominal wall reconstructed. Following an adequate period of observation the sound is removed and the opening allowed to close. Cystoscopic control and eventual biopsies are instituted methodically during the post-operative period and subsequently.

Bruni has treated 8 cases in this manner 3 of which have already been reported in 1932. The ages of the patients ranged from 45 to 63 years. The histologic diagnosis was papilloma in an advanced stage of cancerous degeneration in 3 cases and various types of carcinoma in the 6 other cases. The total doses given ranged from 16,000 to 48,000 roentgens, and the number of fields used from one to six. The dose given to each field was 8,000 roentgens except in 2 cases in which 16,000 roentgens were used. No immediate or late or local or general disturbance was observed.

Immediate cure was obtained in all patients except one who died on the third postoperative day from cardiocirculatory insufficiency. Permanent cure must be accepted for the 3 patients who were operated upon 7 1/2 and 6 1/2 years ago, respectively. Local recurrence was observed in 2 patients, 24 and 22 months postoperatively. One patient died from acute intercurrent disease 3 months after immediate cure. Two patients were treated too recently (12 and 6 months ago) to allow speaking of permanent results. It would thus seem that the method deserves further trial because its innocuity must be considered as established. This will allow improvement of the technique and determining the indications on a more secure basis. In the mean time the method should not be used when complete surgical removal of the tumor is possible without complete removal of the bladder. It may be used when it will allow a more economical intervention, as in one of the present cases in which the tumor involved a ureteral orifice and irradiation made ureteral reimplantation unnecessary with immediate and late favorable results. The method should be considered in cases in which the site or extension of the tumor makes partial cystectomy impossible and total cystectomy necessary and also in cases in which the spread of the tumor, the general condition of the patient and the presence of metastases do not allow total cystectomy and make recourse to symptomatic treatment imperative.

RICHARD KIMMEL, M.D.

## GENITAL ORGANS

**Retropublic Prostatectomy** GEORGE AUSTIN, JR.  
AND WILLIAM C. QUINBY *N. England J. M.* 1934,  
39: 35

Until recently three principal operative approaches to the prostate had been accepted as satisfactory: perineal prostatectomy, suprapubic transvesical prostatectomy and transurethral prostatectomy. No one of these procedures alone is applicable for the treatment of every type of prostatic obstruction. In spite of the contention of surgeons who are strong proponents of one method to the exclusion of the others, it seems fair to say that each of these procedures has certain indications and contraindications, as well as certain limitations and disadvantages, and that each is attended by various technical difficulties that may render the results of operation unsatisfactory. Therefore, when a new and logical method of treatment is proposed, which apparently produces good results in intelligent hands, the progressive surgeon must examine it carefully.

In 1915 Millin of London presented his initial report of a new extravascular technique of prostatectomy—a suprapubic operation for nonmalignant lesions of the prostate to which he applied the name "retropubic prostatectomy." Although Millin considered his operation original, he noted that a somewhat similar suprapubic extravascular approach to the prostate had been made and reported by others. He referred to the reports of Van Stockum in 1909 and of Jacobs and Casper in 1933.

In his initial publication Millin reported the results obtained in 20 patients with benign prostatic disease who were operated upon by this method; 13 of the patients had generalized hypertrophy, 2 had fibrous glands with a sclerotic bladder neck, 1 had calcareous disease, 2 had pure lateral-lobe hypertrophy, 1 had generalized hypertrophy associated with a prostatic abscess, and 1 had postprostatectomy scarring of the prostatic urethra. There were no postoperative deaths, and complications were few. There were 3 cases of minor delayed bleeding, both in patients who had had grossly infected bladders before operation, which was easily controlled by the use of an indwelling catheter for 48 hours. No cases of immediate hemorrhage, gross infection, pyelonephritis or renal failure were encountered. A femoral vein thrombosis developed in 1 case and an abscess of the testis in another. In only 3 cases was there suprapubic leakage of urine after removal of the urethral catheter on the sixth or seventh postoperative day and in these cases it was felt that this occurrence was the result of initial faulty adjustment of the catheter. Concerning the long term follow-up results, Millin believed that it was too early to pass a verdict on the incidence of postprostatectomy obstruction, but subsequent reports from his clinic have shown that postoperative constriction of the vesical neck occurs occasionally. For that reason he has made a modification in his original technique which is described.

In summarizing the features of the retropubic operation the authors believe that the Millin technique is particularly suited for treatment of the following types of prostatic disease: benign hypertrophy of the lateral lobes or of the lateral lobes and the median lobe combined; benign hypertrophy of the median or subtrigonal lobes when intravesical extension is not marked; and calculous disease of the prostate particularly when associated with benign hypertrophy. With increasing experience and future developments in technique this approach may also prove to be a good method of performing plastic procedures in the prostatic nethra and at the bladder outlet.

At present the Millin operation is not indicated for the treatment of patients with obstruction due to sclerosis of the vesical outlet and prostatic fibrosis. In such cases transurethral resection is the preferred procedure. In cases of prostatic obstruction associated with disease of the bladder in which surgical therapy of both lesions is required transurethral resection is preferred also. In this category may be grouped patients with prostatic obstruction who also have a vesical tumor, large vesical calculi, a poorly draining diverticulum with or without tumor, and any other vesical lesion necessitating surgery. And finally for the reasons mentioned before it is believed that the retropubic operation is not suited to the treatment of early carcinoma of the prostate.

The pertinent literature concerning a newly proposed method of retropubic prostatectomy is briefly reviewed, and the advantages and disadvantages of the procedure are discussed.

The indications and contraindications for the employment of this operative approach are presented in the light of a limited experience with the operation.

The technique of the operation is outlined, and a summary of the results obtained in a selected group of 20 cases is recorded.

JOHN E. KIRKPATRICK, M.D.

**Estrogenic Hormone Therapy of Prostatic Carcinoma** (Ormonoterapia estrogena del carcinoma prostatico). PASQUALE BRUNI. *Gior ital chir* 1943, 4, 196

In 20 cases of prostatic carcinoma observed at the Surgical Clinic of the University of Naples the ages of the patients ranged from 52 to 76 years and the disease had been present from a few weeks to 9 years. 13 cases were primary carcinomas and 7 were degenerated adenomas. Bone metastases were radiologically demonstrated in 4 cases. Epicycstostomy was performed in 8 cases and roentgenotherapy in 3. Sixteen patients were subjected to active hormone treatment orally or parenterally and 4 to castration alone. The doses of estrogen ranged from 2 to 15 mgm. per day. The best method is to start with an attack dose of from 8 to 15 mgm. daily and to pass to a maintenance dose of from 3 to 5 mgm. daily. The duration of treatment to date has varied from 31 months to 15 days. In 2 cases suspension of treatment was followed by rapid aggravation, but re-

sumption of treatment allowed the patients to regain what they had lost. In one case the treatment caused attacks of bladder tenesmus which induced the patient to suspend treatment several times; the result of the treatment was negative during the 18 months it was applied.

The results of treatment were favorable in 14 patients (70 per cent), negative in 3 (15 per cent) and unknown in 3. Late results can be considered only in cases in which the hormone treatment has been administered for at least 12 months. Of 6 patients fulfilling this condition one obtained no benefit but in 5 there was marked improvement. One of these died of extraneous disease after 12 months; another died of uremia and urosepticemia after 22 months; and a third died of gradual cachexia despite 30 months of successful treatment. The last 2 are in good condition after 31 and 20 months, respectively.

Castration performed in 4 patients without associated stilbestrol therapy dates back 6, 5, 3, and 2 months, respectively. Although it is impossible to speak of late results, its favorable results in 100 per cent of the cases stand out against the favorable results in only 62.5 per cent; the negative results in 18.7 per cent, and the unknown results in 18.7 per cent as obtained with hormone therapy. In addition it is to be noted that the systematic favorable results of castration were early and conspicuous, while those of hormone therapy were not so constant, so imposing, nor so early.

From the point of view of the results obtained with hormone therapy there was no observable difference in behavior between cases of primary cancer and cases of degenerated adenoma.

RICHARD KEMEL, M.D.

## MISCELLANEOUS

**Transperitoneal Dialysis.** RONALD W. REID. *Proc R. Soc. M. Lond.* 1943, 41, 413.

The accumulation of toxic metabolites, alterations in the osmotic pressure of body fluids, dehydration, excessive hydration, electrolyte imbalance, and acid base alterations are a few of the many factors involved in producing the clinical entity called uremia.

The composition of the body fluids is estimated to be: vascular, 3 liters; interstitial fluids, 11 liters; and intracellular, 35 liters for a 150 pound man. These various factors account for about three quarters of the body weight. Interchange between these three types constantly occurs. Potassium and phosphorus are the ions concerned in the composition of the intracellular fluid. Apparently the cell membrane, in contrast to that of the capillary, is impervious to most electrolytes.

The relationship of the kidney to the fluid in the vascular system and the remainder of the extracellular fluid is shown by an illustration. It is apparent that the function of the kidney is to maintain the physical and chemical constancy of the body fluids and to eliminate waste products. On decreased renal function resulting from disease de-

hydration or lack of salt or other essential factors for proper function change in the body fluids occurs and waste products accumulate. While the exact nature of the change remains in doubt it is known that urea and phenols increase in the blood stream when renal insufficiency exists. While urea, even in high concentrations is not toxic the determination of the urea blood level serves as an index to the severity of the uremia. The basic concept of the treatment of uremia by dialysis is that the physical and chemical composition of the extracellular fluids, excluding protein can be influenced by contact across a semipermeable membrane whether by means of an artificial kidney or by peritoneal lavage.

The contact with the extracellular fluids achieved by means of the artificial kidney is illustrated.

Four principles are considered to be involved in the treatment of uremia (1) where possible remove the cause (2) reduce the kidney load (3) substitute renal function by artificial means and (4) relieve symptoms without prejudicing recovery.

A thorough urological survey should be carried out. Protein breakdown should be reduced to decrease the amount of metabolic products to be excreted. Carbohydrates should be substituted for protein. Fluids or diuretics should be avoided since water and urea usually exist in sufficient amounts. Existing anemia should be corrected. Six cases are presented in detail. The first patient received an incompatible blood transfusion treated with vast quantities of parenteral fluids. Anuria developed with an accompanying blood urea of 53 mgm. per cent. Subsequent ineffectual treatment consisted of cystoscopic irrigation of both kidneys under high spinal anesthesia. On the tenth day bilateral renal decapsulation was followed immediately by peritoneal lavage with 2,000 c.c. of twice normal saline solution with a 2,100 c.c. recovery of the perfusate. Simultaneously the patient began to void via a urethral catheter as well as pass urine via the renal dialysis. On repeated days, peritoneal lavage was performed with a total of 6,000 c.c. of twice normal saline solution with recovery of 2,500 c.c. containing 6 gm. of urea. However recovery was attributed to renal decapsulation.

Although peritoneal lavage was not directly responsible for recovery in the second case it was noted that the concentration of urea in the peritoneal fluid was higher than that in the blood. The chloride concentration of the dialyzing fluid increased. The knowledge gained from the preceding 2 cases was applied to the subsequent cases. Normal saline solution was used in the third case instead of twice normal saline solution. With this solution the blood urea was decreased from 203 to 195 mgm. per cent. No ill effects were noted until the fourth case in which similar therapy was employed. Death in this case was from pulmonary edema as a result of overloading the patient with water and chlorides.

Five per cent glucose in water was used as the dialyzing fluid in the fifth case. Intermittent lavage permitted recovery of 385 gm. of urea as well as 52

gm. of chloride. Five per cent glucose in normal saline solution was used as the dialyzing fluid in the sixth case. Although no ill effects were observed from the lavage, recovery as in the previous cases, was attributed to other methods of therapy.

It is obvious from these studies that urea and presumably other toxic products can be removed from the blood stream with clinical improvement, but it is difficult to translate this into statistical terms. The maintenance of the electrolyte balance is most important. Following peritoneal lavage the concentration of urea in the wash may exceed that in the blood stream.

Intermittent injection and withdrawal is safer than continuous perfusion. The fluid used should permit rapid diffusion of the waste products, should not grossly alter the electrolyte and water balance of the extracellular fluids, should have an osmotic pressure near that of plasma and be adjusted to combat acidosis and alkalosis. Peritoneal lavage is advocated in cases of temporary renal suppression when the return of renal function is possible.

PETER L. SCARDINO, M.D.

#### Dialysis of Blood for the Treatment of Uremia.

E. M. DARMADY. *Proc. R. Soc. M. Lond.*, 1918, 4, 4 B.

Previously encountered difficulties in treating uremia by blood dialysis having been overcome with the use of a cellophane tube and a method of spreading a small quantity of blood over a large dialyzing surface, the author submits his method for the treatment of uremia.

The patient is heparinized with from 200 to 300 mgm. of heparin. In case sudden hemorrhage occurs blood transfusions and protamine sulfate are given. Blood is extracted from the radial artery and controlled synchronized pumps regulate the inflow and outflow. The machine is first filled with compatible blood. The dialyzing tubing is wound around a rotating drum to permit the spread of a small quantity of blood over the dialyzing surface as well as to agitate the blood. By synchronizing the drums to the pump so that 20 ml. of blood enter the machine for each complete rotation a better and more even film is produced. The author's instrument has a series of plates 1/8 inch apart through which a tube of cellophane is led. The flow of dialyzing fluid is arranged by means of a number of small tubes in the plates which allow the dialyzing fluid to flow outward from the center in either direction.

The author believes that failures are due to the dialyzing fluids now available and looks forward to a fluid which will be not only isotonic but also isosmotic.

PETER L. SCARDINO, M.D.

#### The Artificial Kidney: Its Clinical Application in the Treatment of Traumatic Anuria. E. G. L. BRYAN AND A. M. JONES. *Proc. R. Soc. M. Lond.*, 1918, 41, 470.

Lesions of the distal convoluted renal tubule (low or nephron nephrosis) are produced in many ways

vessel rupture muscle rupture electric shock, flogging hemolysis, Welch's infection intravenous water in transurethral prostatic resection intravenous soap in abortion and sulfonamide hemolysis.

It has been demonstrated that after the first week, the affected epithelium is desquamated and excreted in the urine as a cellular coat to the pigment cast with regeneration and mitosis from the basement membrane and finally, diuresis. Prior to the advent of the artificial kidney methods of combating uremia were usually unsatisfactory. While potassium levels could be reduced with insulin by depositing this electrolyte intracellularly, dilution of the protein metabolites with saline solution frequently produced severe pulmonary edema. Purging and sweating did not remove more than an insignificant amount of metabolites.

The artificial kidney is best suited to that case in which recovery of renal function is expected that is one in which either functional disorder or disease affecting the tubules does not involve the glomeruli. The artificial kidney is probably most useful in lower nephron disease.

Details of the 2 cases successfully treated by dialysis are given.

A patient suffering traumatic anuria with a blood urea of 390 mgm. per cent was dialyzed for 5 hours with removal of 32 gm. of urea. The third day after dialysis a secondary rise in blood urea occurred but was overcome by diuresis. The blood urea was decreased by 179 mgm. per cent to 211 mgm. per cent. Recovery was satisfactory.

The second successfully treated case was that of a patient who developed pigment nephrosis fol-

TABLE IV—COMPOSITION OF BATH WATER

Constituents		Concentrations per 100 ml.	
600 grams NaCl	Calcium		3 mgm.
1500 grams Glucose	Glucose		1,500 mgm.
200 grams NaHCO <sub>3</sub>	Chloride (as NaCl)		630 mgm.
40 grams KCl	Sodium		390 mgm.
100 liters tap water	CO <sub>2</sub> (C.P.)		54 ml.
	Potassium		20 mgm.

\*Combining Power

lowing anesthesia. After one 4 hour period of dialysis on the twenty-sixth postcholecystectomy day 33 gm. of urea were removed which reduced the blood urea from 424 to 264 mgm. per cent. After that, except for a transient blood urea rise the urine output increased and the renal function as well as the blood urea fell to normal. The author has modified the Kolff apparatus which he describes in detail. The modification avoids the excessive pressures under which the blood was formerly pumped from the machine into the patient's vein. Other technical details are discussed including the composition of the bath water (Table I) and methods for regulating the venous replacement of arterial outflow.

Adjuvant therapy consists of amidopyrine (0.6 gm. 6-hourly for 24 hours) sodium pentothal anesthesia, penicillin, and calcium gluconate. Such substances as thiamine and ascorbic acid have been added to the circulating blood. During the recovery period a high carbohydrate diet has been administered as well as testosterone to increase tubular regeneration. It is suggested that dialysis is applicable in other conditions. Large quantities of aspirin were removed by dialysis from an aspirin poisoning case.

PETER L. SCARDINO M.D.

# SURGERY OF THE BONES, JOINTS, MUSCLES, TENDONS

## CONDITIONS OF THE BONES, JOINTS, MUSCLES, TENDONS, ETC.

The Syndrome Called Osteitis Fibrosa (Die Begrenzung der Osteitis fibrosa) HANS HELLNER *Chicago*  
947 17- 8 45 1909.

Konjetny who first differentiated giant cell sarcomas from true sarcomas, pointed out that localized osteitis fibrosa can be found in any bone disease. In osteomyelitis tumors juvenile cysts, and benign giant cell tumors. The findings of localized osteitis fibrosa indicate only that a tumor or an inflammatory focus in bone caused activation of fibrous tissue within the Haversian spaces. There is usually by peremla which may be on an inflammatory or mechanical basis with an increased formation of osteoclasts. Increased bone destruction initiates bone formation increased numbers of osteoblasts and irregularly dispersed osteoid tissue. The term osteitis fibrosa should be limited strictly to one specific condition. There are eight distinct entities

- 1 Osteitis fibrosa generalisata cystica (Recklinghausen a disease)
- 2 Osteitis deformans (Paget)
- 3 Renal osteitis fibrosa in adults. This disease is identical with that given as number 1. Renal osteoporosis shows no relationship with osteitis fibrosa.
- 4 Juvenile bone cysts.
- 5 Polycystic osteitis fibrosa of one or several bones is part of the juvenile bone cysts and does not require a separate classification.
- 6 Giant cell tumors of early adult life. Cysts and giant cell tumors have some histological features in common

7 The so-called polyostotic osteitis fibrosa has nothing whatever in common with osteitis fibrosa. The name precocious puberty with bone dysplasia is a better term.

8. Renal osteitis fibrosa or renal rickets should be considered as a separate entity

A discussion of each entity follows

1 Osteitis fibrosa generalisata (Recklinghausen) is an endocrine disturbance affecting the entire body. The generalized decalcification of the skeleton is based on a disturbance of the mineral metabolism. An adenoma of the parathyroid glands is usually found and may be the cause or the consequence of the metabolic disturbance. The Enlbheim theory of secondary involvement of the parathyroids appears to be acceptable. Hypertrophy of the parathyroid glands is found in osteitis fibrosa, osteomalacia, rickets, cancer of bone, multiple myeloma, and osteitis deformans. Hypertrophy of the parathyroid glands usually appears after the decalcification has reached a high level and thus a vicious circle is established. It is the opinion of most authors that an endocrine disturbance of a hypothalamic center causes an acid tide of the metabolism

which is responsible for the decalcification. Later an adenoma of the parathyroid glands plays the leading part in the future development of the disease. There is polyuria and polydipsia. There is hypercalcemia and there is hypophosphatemia. Loss of calcium causes a decalcification of the skeleton and muscle weakness. The weakness of the muscles is manifested by decreased electric excitability and disturbance of the muscle metabolism (hypophosphatemia). There is softening of the bones which causes bowing and fractures. There is evidence of decalcification thinning of the cortices, and widening of the marrow cavity (Decalcification of the skeleton can be noted on the roentgenogram only after 10 per cent of total calcium loss). The changes which made Recklinghausen consider his disease as a cystic degeneration of the entire skeleton are a secondary manifestation.

One must remember that he is observing certain phases of a syndrome. Cysts and giant cell tumors in osteitis fibrosa can be easily discovered clinically because of the local bone enlargement. Occasionally the weak bone shell perforates and severe hemorrhages occur. Cysts of osteitis fibrosa are the result of organization of hemorrhages and are therefore later stages of giant cell tumors.

Single bone cysts usually occur in early life. Osteitis fibrosa generally is found between the ages of 40 and 45 and mostly in women. The diagnosis of a single giant cell tumor in adults therefore warrants a thorough examination of the entire skeleton and the metabolism. Local surgical treatment, i.e. scraping of cysts and giant cell tumors and the insertion of bone grafts will be of no avail if an adenoma of the parathyroid glands is present. Excision of the adenoma will eliminate the vicious circle which causes severe decalcification of the skeleton, and help in the treatment of nephrolithiasis, pyelitis and albuminuria. Muscular power will greatly improve. Cysts and giant cell tumors can be treated surgically after the parathyroid glands have been removed. In spite of the fact that the parathyroid plays a secondary part in osteitis fibrosa occasionally complete recovery has been observed after removal of the parathyroid glands.

2 Osteitis deformans (Paget). In Paget's disease a chronic nonspecific osteitis is found. There is a hereditary factor as well as a constitutional factor. There is no endocrine disturbance. The blood content of calcium and phosphorus is unchanged and may occasionally show a decrease of calcium and an increase of phosphorus. Parathyroid adenomas are absent. Occasionally there is parathyroid hyperplasia similar to that found in any other bone disease in which decalcification occurs. There is a serious inflammation of the bone marrow and a disturbance of the bone lamellae structure which is manifested by irregular apposition and destruction

of the bone. A mosaic type pattern with increased cement lines is noticeable, this is characteristic but definitely not specific of Paget's disease. The slow change in bone structure in Paget's disease leads to an increase in thickness of the bones. The bones are weak and spontaneous pathologic fractures occur. Roentgenograms of the entire skeleton are characteristic. Coxa vara, saber shaped tibia, and deformities of the radius are common. The full blown picture of Paget's disease is characterized by a large head thick bones and ape-like posture. Surgery is indicated in the case of compression of the spinal cord or of the spinal nerves within the foramina.

3. Renal osteitis fibrosa in adults. The differentiation of a renal form of osteitis fibrosa generalisata in adults in which the skeletal changes are associated with kidney changes is not justified. In 50 per cent of all cases of osteitis fibrosa in which there are changes of the mineral metabolism, the formation of cysts and brown tumors and damage of the kidneys are found. Uehlinger suggests the name renal osteopathy of adults for bone changes with kidney damage. Mandibular changes observed in experimental poisoning with platinum, gold, iron, or tin reach the jaw by way of the kidneys. Damage of the kidneys may cause decalcification of the skeleton. Hyperplasia of the parathyroid glands occurs secondarily.

Giant cell tumors and bone cysts occur without any other signs and are found in adults as well as children. Adults are more likely to have giant cell tumors and children more often cysts. The term "local osteitis fibrosa" is not good.

4. Bone cysts in infants. Bone cysts found in children and adolescents have no relation to Recklinghausen's disease. No known case of a single bone cyst followed up for 30 years later developed into Recklinghausen's disease. Hemorrhages within the bone marrow may be the cause of bone cysts or the cysts may be due to mesenchymal tumors (hamartia). Giant cell tumors are true tumors which may precede the bone cysts. The juvenile bone cyst is usually discovered after it has reached a considerable size or has caused a spontaneous fracture. The bone cyst originates either by hamartia of tissue composed of fibrocytes or from bone marrow hemorrhage. The histological picture will vary according to the biopsy site and the etiology of the lesion. Juvenile bone cysts are located in tubular bones within the metaphysis and are found in children under 15 years of age. Bone cysts found in adults usually originate from giant cell tumors. The upper humerus, the femur and the tibia are more frequently affected than any other bones. The roentgenogram is that of a multilocular cyst and is well demarcated proximally and distally. The cortex is very thin. There is no periosteal reaction. There is no disturbance of mineral metabolism. There is never any evidence of hyperparathyroidism. A biopsy is not necessary. One is not unlikely to mistake a bone cyst for a sarcoma on x-ray examination or on the basis of a clinical examination.

The treatment of osteitis fibrosa consists of the insertion of bone grafts. In cases of incomplete fracture, immobilization alone may lead to complete cure. At operation the juvenile cyst reveals a chocolate brown or serous colored fluid. A brown tumor type of tissue is found only in the walls of the cyst or giant cell tumor type tissue. The insertion of bone grafts is important because it takes a long time for big bone spaces to heal without the help of additional osteogenic tissue. Bone cysts of flat bones in children usually are composed of giant cell tumor tissue. Rarefaction in bone on roentgenograms may indicate a true cyst or a giant cell tumor. Experience has taught the author that large multilocular cyst formations in the long bones of children usually indicate juvenile cysts and that smaller multilocular cysts with thick partitions within the epiphyses in adults indicate giant cell tumors. Small cysts within the cortex in adults usually contain giant cell tumor tissue.

5. Polycystic localized osteitis fibrosa may affect one bone or an entire extremity. A similar picture is found in juvenile bone cysts. Histological examination reveals giant cell tumor tissue and cyst formation. There is no endocrine disturbance and there is no disturbance of mineral metabolism. The treatment is the same as for juvenile bone cysts.

6. Giant cell tumors. The syncytial fibroblastic giant cell tumor formation which is found reactively in osteitis fibrosa generalisata occasionally is observed separately and has to be considered as a true tumor. There is no disturbance of mineral metabolism. It seems unreasonable to believe that giant cell tumors in osteitis fibrosa generalisata are the result of bone marrow hemorrhages and to assume that giant cell tumors which occur independently are true tumors. Dense fibrous tissue within a scar may resemble a true fibroma. Hyperostoses may resemble true osteomas. The benign giant cell tumor usually occurs within the epiphyseal ends of the long bones in young adults. Giant cell tumors occur also in flat bones. The cortex becomes thin because of the expansive growth of the tumor and may occasionally stimulate growth by infiltration. Occasionally perforation of the periosteum is seen. In these cases differential diagnosis from osteogenic sarcoma is very difficult and the biopsy is the deciding factor. The treatment consists of curettage, implantation of bone grafts and fusion in cases in which joint destruction is present. Unfortunately there is a malignant variant of giant cell tumor which is a true sarcoma. Repeated incomplete excisions of the tumor, irradiation and postoperative infection may be the cause of malignant changes.

Small cystic foci are occasionally seen in the cortices of the long bones. The histological examination usually shows giant cell tissue and rarely cyst formation. These cysts are caused by endogenous or exogenous causes for example bacterial emboli.

7. Polyostotic osteitis fibrosa. This is an endocrine disturbance associated with changes in the bones. There is never a parathyroid adenoma.



present. A better term would be polyostotic fibrous dysplasia associated with pigmentation of the skin and endocrine dysfunction. The familiar occurrence, its appearance in young individuals and its unilateral occurrence points to a gene-associated condition. There is no metabolic disturbance. There is always precocious puberty.

8 Renal osteitis fibrosa in children. This condition is known as renal rickets and was formerly known as renal dwarfism. Renal rickets is a disease which occurs in early adolescence with retardation of growth, pallor, fatigue, polyuria, and polydipsia. The urine contains albumin and cylinders. There is hyperproteinemia and increased blood pressure. Fractures and bowing of the long bones are found. Occasionally the x-ray examination reveals signs characteristic of rickets. Irregular epiphyseal lines, cup formation, osteoporosis, and infarctions are present. Originally interstitial nephritis was considered to be the cause of renal rickets. More recently kidney atrophy and pyelonephritis were considered the etiologic factors involved. In many cases an infection is implanted in a congenital malformation of the kidneys.

The bony changes associated with chronic insufficiency of the kidney usually cause parathyroid hyperplasia, which is also found in rickets. Eager caused kidney damage in rats with uranium nitrate, which usually was followed by hyperplasia of the parathyroid gland and osteitis fibrosa changes in bones. The changes in the bones are caused by way of the parathyroid glands and are similar to the ones observed in renal rickets. It was found that the bone condition was greatly improved by the administration of vitamin D and AT 10. Vitamin D has no influence whatsoever on osteitis fibrosa. Renal rickets is a disease which sometimes resembles osteitis fibrosa and sometimes true rickets.

Osteitis fibrosa is characterized by (a) a mineral metabolism disturbance with a negative calcium balance and a hypophosphatemia (organically) (b) permanent changes in the bones and parathyroid adenoma (morphologically) and (c) muscle weakness, deformities due to bone cysts and bone tumors, and secondary damage to the kidneys (clinically). The cause of osteitis fibrosa probably is a complex disturbance of the endocrine glands with particular emphasis on the parathyroids. A vicious circle is set up with an increased amount of decalcification of the skeleton. This sets up another vicious circle because as the result of the damage to the kidneys, "acidosis" follows and this in itself again causes decalcification of the skeleton. In rickets the following symptoms are found (a) organically disturbance of the mineral metabolism, especially lowering of the phosphorus blood levels with negative phosphorus balance, (b) morphologically: a decrease in calcification within the zone of temporary calcification at the epiphyses, increased formation and noncalcified osteoid in the same area (c) clinically softening of the bones, especially of the calvarium and growth disturbance of the epiphyses with enlargement and bowing of the

bones. In addition there is disturbance of the tooth enamel. The calcium and phosphorus blood levels are important as well as the calcium-phosphorus ratio. Rickets occur at a calcium-phosphorus ratio of at least 4 to 1. The excess calcium salts can be excreted only with the help of phosphorus, with the result of a decrease in the phosphate salts. The phosphate concentration in the serum drops below the level necessary for ossification. Vitamin D medication not only improves the intestinal phosphorus resorption but also improves the utilization and retention of phosphorus in the bones. In infantile rickets hypophosphatemia is discovered prior to the bony changes. Decalcification of the skeleton goes hand in hand with changes in the mineral metabolism. It may be due to (1) dietary calcium deficiency (2) deficiency of phosphorus, or a discrepancy between the calcium and phosphorus levels, (3) lack of vitamin D (4) lack of ultra violet rays, (5) lack of vitamin C (6) disturbance of the endocrine glands and (7) a general disturbance of the metabolism resulting in acidosis. There is a definite relation between vitamin D and the parathyroid glands, calcium and phosphorus metabolism, vitamin D and fat metabolism and between vitamin D and lack of ultra violet rays, and between acidosis and parathyroid activity. Osteitis fibrosa generalisata cannot be considered exclusively as a bone disease. The calcium-phosphorus metabolism is disturbed and since the skeleton is the main source of these minerals it shows marked changes in its morphology. There is a common central origin\* for both osteitis fibrosa and diabetes. Both appear predominantly around the time of the menopause at the time when there is a re-arrangement† of the endocrine glands. Women are predominantly affected, and pregnancies prior to the onset of the symptom influence the course of the disease.

Osteopathies in which decalcification of the skeleton occurs as evidenced by osteoporosis may lead to pathologic fractures. The more severe decalcifications lead to malacias which cause bowing of the bones.

GEORGE I. REISS, M.D.

**Ischemic Contracture, Local, in the Hand. STERLING BURNELL, EDWARD W. DOWERTY and RAYMOND M. CURTIS. *Plast. Reconstr. Surg.* 948, 3: 424.**

Ischemic contracture of the hand is a disabling fibrous degeneration of the intrinsic muscles of the hand which can be improved by surgery. It is caused by a tight plaster cast, injury to the brachial plexus, trauma to the two main arteries of the arm, or any other type of constricting bandage causing decreased circulation in the hand.

The hand assumes the position of a claw and there is adduction of the thumb. The fingers are flexed at the proximal joints and extended at the distal joints and there is flexion of the metacarpophalangeal joints. This position is similar to the one seen in combined paralysis of the median and ulnar nerves. The changes in the hand are permanent. The pulse is present except when the main artery is interrupted.

The tensesness of the interossei is demonstrated by failure of active or passive flexion of the distal two joints of the finger on hyperextension of the metacarpophalangeal joints. There is little or no active motion of the thumb.

Incision of the fascial covering of each intrinsic muscle is beneficial in early cases. In older cases stripping of the interossei and allowing them to retract distally is of benefit only if there is still some activity in the muscle. In cases in which only fibrosis is discovered complete tenotomy is done and a sublimis tendon is transferred at a later date.

The thumb is mobilized by bisecting the cleft and by holding it in that position by a bone block or by a pulley transfer operation by opposition. The defect in the skin is closed with a skin flap.

GEORGE I. REINS, M.D.

**Early Coxa Plana. Age Studies.** *FOLKE STRÖM, Ada. Erikop scand., 1948, 17, 180.*

The author's study was undertaken to determine the age of patients at the onset of coxa plana, and whether an earlier age of onset is associated with more rapid healing. The healing time in coxa plana is compared with that of aseptic necrosis of the femoral head following closed reduction of congenitally dislocated hips.

In order to estimate the duration of the disease prior to the initial roentgenogram serial films of 103 cases were studied. This information, together with opinions expressed in the literature helped to establish the following criteria.

Cases presenting early changes accompanied by more or less pronounced sclerosis of the caput epiphysae were considered as having existed for at least 3 months. If conspicuous fragmentation was visualized its duration was believed to have been 9 months and if the healing process was evident on first examination it was considered that the pathological process had existed at least 18 months prior to examination. A more accurate evaluation of the ages of the disease was deemed impossible.

The average age of patients at the first examination was 7 7/8 years. The highest age was 13 years and 1 month the lowest, 2 years and 5 months. The lowest estimated age at onset of the disease was 2 years and 2 months and the highest age at onset was 13 years and 1 month in a patient who was under observation for the opposite earlier affected hip. The average estimated age of patients at onset was 6 6/8 years. Usually the condition was observed about 1 year prior to the first visit to the diagnosing surgeon so that the disease had progressed markedly before treatment was initiated.

Beginning resorption of earlier affected parts was considered the first sign of healing and on this basis the average healing time was 16 months. The shortest period required for healing was 7 months and the longest at least 34 months. Healing was a little slower in the older age groups.

Of the small total of 23 cases of coxa plana which were followed up at regular intervals (from the be-

ginning of the condition until restitution with substantially normal bone structure in the caput epiphysae), the average period of evolution was 36.6 months—the shortest, 21 months and the longest 54 months. The average healing time in patients under 7 years of age was 35.0 months and in patients over 7 years of age 38.6 months.

In 22 cases of epiphysitis following reposition of a congenital hip dislocation the average time of onset was 3 7/8 months following reduction the shortest interval was 2 months and the longest, 7 months. The average age of these patients was 2 7/8 years the youngest being 1 year old and the oldest 7 years old at the onset of the epiphysitis. In 16 cases studied sufficiently to determine the onset of healing 8.4 months was the average time 5 months was the shortest, and 12 months the longest time. This may be compared with an average of 16 to 18 months in coxa plana. Only 6 cases were followed long enough to determine the time required for complete healing after reposition—an average period of somewhat less than 2 years.

The author's analysis seems to bear out the generally assumed fact that aseptic necrosis of the femoral head in childhood heals in the shortest time in the youngest patients.

KENNETH H. SPONDEL, M.D.

**Significant Anatomic Relations in the Syndrome of the Scalene Muscles.** *HOMER D. KIRBY and ADRIAN F. REED. ANN. SURG., 1948, 127, 1182.*

Bilateral dissections of the area in question were done on 56 cadavers in an effort to discover significant anatomic relations. Particular attention was directed toward the modifications in structure and anatomic relations of the scalene muscles, the components of the brachial plexus and the adjacent vessels.

In all cases most of the fibers of the scalenus anticus muscle arose from the anterior or inferior surface of the anterior tubercles of the cervical transverse processes from the third to the sixth cervical vertebrae inclusive. These fibers even if in marked spasm are not strategically located to compress adjacent roots of the brachial plexus. The only possible way for this portion of the muscle to contribute to the syndrome is by elevation of the rib to which it is inserted with consequent trauma to the lower trunk of the brachial plexus. It is possible that such elevation of the first thoracic rib might, in some cases, constrict the lumen of the subclavian artery.

The location and size of the scalenus medius muscle are not suitable for the muscle to assist greatly in elevating the first rib. The effectiveness with which the scalenus medius muscle functions in raising the rib is to a large extent dependent on the size of the muscle and the distance of its insertion from the point about which the rib rotates as it is raised. The distance between the point of emergence of the first thoracic nerve from the intervertebral foramen and the point at which it crosses the scalenus medius muscle is an index of the amount of traction which

may be exerted upon the nerve with contraction of the muscle. This distance was established approximately by measuring the interval between the head of the second rib and the anterior point of attachment of the scalenus medius to the first rib. I practically all dissections the lower trunk of the brachial plexus rested on the inferior portion of the anterolateral margin of the scalenus medius muscle as it descended into the upper extremity regardless of the relation between the attachments to the first rib of the scalenus anticus and medius. The anterolateral border of the spastically contracted scalenus medius muscle may act as a sharp ridge over which the component roots of the brachial plexus, especially the seventh and eighth cervical and the first thoracic roots, are drawn by the normal activity of the upper extremity.

The author concludes that it is impossible for the main body of the scalenus anticus muscle that is, that portion arising from the anterior surfaces of the cervical transverse processes, to compress directly the components of the brachial plexus. This part of the muscle is important in the syndrome only through its activity in elevating the first rib and in serving as a rigid structure against which the displaced subclavian artery may be compressed. However direct compression of the fifth sixth and seventh cervical nerves especially of the latter two may result from contraction of the bundles of muscle fibers which arise from the inferior and posterior aspects of the cervical transverse processes and join the main body of the scalenus anticus muscle.

There are several factors which are of importance in the production of this syndrome of the scalenus muscles, namely (1) elevation of the first rib by the activity of the scalenus anticus and medius muscles aided by the scalenus minimus muscle when the latter is present, with irritation to the lower components of the brachial plexus (2) contraction of the "posterior" components of the scalenus anticus muscle with compression of the immediately adjacent nerve root or the subclavian artery and (3) traction of the components of the brachial plexus especially the seventh and eighth cervical and first thoracic nerves, across the anterolateral margin of a spastic scalenus medius muscle.

The vertebrocostal ligament occupied the characteristic position of the scalenus minimus muscle bilaterally in 10.7 per cent and unilaterally in 3.5 per cent of the dissections. The attachments were found to be similar. This ligament becomes relaxed as the rib is elevated. The situation in which it would carry out such a function most efficiently is one in which the scalenus medius contracts sufficiently to displace the first thoracic and eighth cervical nerves but not enough to elevate the first rib.

The surgical treatment of the scalenus muscles should include resection of the major portion of the scalenus anticus and of the scalenus minimus or vertebrocostal ligament when either of the latter is present. In addition, if it is apparent that the lower trunk of the brachial plexus may be traumatized

by angulation across the anterolateral border of the scalenus medius as is suggested by the approximation of its insertion to that of the scalenus anticus the portion of the scalenus medius immediately posterior to the lower trunk of the plexus should be resected.

C. FRED GOFFINGER, M.D.

**Traumatic Necrosis of Prefibular Muscles.** CARL PLECKOW, RAYMOND D. ADAMS, and D. DENNY BROWN. *N. England J. M.* 1948, 330-313.

A 24 year old man who had emigrated from Greece less than a year prior to this report was employed as a bus boy, and his duties required a considerable amount of walking. After competing with two companions in broad jumping on a cement pavement, he experienced sharp pains in the anterior aspect of both lower legs.

Examination revealed a foot drop bilaterally and complete paralysis of the anterior tibial muscles, the extensor digitorum longus and the extensor hallucis longus muscles. The neurologic examination was negative. The man's temperature was 100.8 degrees, and albuminuria and mild leucocytosis was found. Tests for parasites and venereal diseases and x-ray examinations were negative.

On the third hospital day the patient appeared ill, and his temperature rose to 103.4 degrees. The patient was given penicillin intramuscularly. On the fourteenth hospital day he was feeling quite well but the foot drop and the paralysis of the muscles persisted. A biopsy of the anterior tibial muscle revealed that parts of the skeletal muscles were replaced by fibrous tissue. In some instances different stages of degeneration were observed. There was some increase of the interstitial fibrous connective tissue. There were many macrophages containing hemosiderin and fewer lymphocytes. There was thickening of the walls of the small arteries.

The patient was seen 5 months after the illness. Bilateral foot drop and paralysis of the anterior tibial muscles were still present. A possible relation of this condition to the so-called "shin splints" was considered. It is believed that the violent contraction of the anterior tibial muscles may have caused rupture of the muscle fibers and hemorrhage, and expansion of the muscle fibers within the tight fascial compartment may be responsible for the ischemia and degenerative changes.

GEORGE I. REES, M.D.

#### SURGERY OF THE BONES, JOINTS, MUSCLES, TENDONS, ETC.

**Open Reduction for Slipping of the Upper Femoral Epiphysis.** STEN FARRER. *Acta orthop scand.* 1948, 17, 189.

At the Karolinska Institute the author has under his care a series of 70 patients, in the early "pre-slipping" state of slipping of the upper femoral epiphysis, who have been treated by the blind method of Smith-Petersen nailing. This method of

treatment is used in those cases in which at least two-thirds of the slipping surfaces are in contact. He believes that the so-called closed reduction is largely an illusion, and the trauma so great that necrosis often results. He does not find traction as satisfactory as the nailing procedure.

Greater slipping occurring at the time of the initial examination is a more serious problem. Since 1944, the author has performed open reduction and nail fixation in 13 severe cases. In the earliest case there was complete acute displacement, which prompted this manner of treatment. One other patient with acute displacement was so treated. Subsequently 11 patients in whom the slipping occurred more slowly have been subjected to open reduction by means of a wedge osteotomy and the nailing procedure. The wedge is taken from the femoral neck adjacent to the epiphyseal line and the base of the wedge is faced ventrally and cranially. The dimensions of the wedge are determined by the degree of slipping and on its estimated duration. In early cases satisfactory reduction is obtained with smaller wedges.

The author wishes to achieve reduction without placing a stretch on the posterior soft tissue connections; therefore the wedge should be large enough to avoid stretching the posterior structures which carry the circulation to the head. He believes that this may explain why no head necrosis has occurred in this series of 11 cases. He further advises that the nail be directed posteriorly into the head in order to rotate it into the osteotomy line. Anterior position of the nail might further displace the head. Illustrations demonstrate the author's insistence on good lateral roentgenograms of the hip.

In 12 of the 13 severe cases the preliminary results have been judged. In 10 of the patients the results are objectively and subjectively very good and necrosis has not been observed up to the present time. In the eleventh case total necrosis was present before operation. In the twelfth case reduction was not satisfactory; this case showed partial necrosis at one time which rapidly resolved. The final case was one in which a slight infection occurred postoperatively, with some decalcification and narrowing of the joint space. The patient considers himself symptom-free but the future of the joint is doubtful.

The author believes that open reduction should be unnecessary in cases in which the diagnosis is made very early. From a technical point of view it is rather difficult, and the necessary condition for a good functional result is an exact reduction. With regard to the late results nothing can be said at this time.

Preoperatively the radiologic examination revealed slight narrowing of the joint space and at operation a softening of the cartilage was seen. A normal hip cannot be expected but the results must be evaluated by comparison with the condition of these patients without operation.

KENNETH H. SPONSLER, M.D.

#### Hamstring Tendon Transplantation for the Relief of Quadriceps Femoris Paralysis in Residual Poliomyelitis. A Follow Up Study of 134 Cases. J. R. SCHWARTZMAN and C. H. CREGO, JR. *J. Bone Surg.* 1948, 30-A 541

A total of 134 hamstring tendon transplantations for the relief of residual quadriceps paralysis in poliomyelitis has been observed including the original 63 cases reported by Crego and Fischer in 1937 in which the biceps femoris tendon alone had been transplanted to the patella. The follow-up periods ranged from 1 to 22 years. An analysis of the end results is presented and the principles, technique and conclusions in the original report are modified.

The results of the present analysis of cases are reported according to the following grouping: (1) transplantation of the biceps femoris alone to the patella; (2) transplantation of the biceps femoris and semitendinosus to the patella; and (3) transplantation of the semitendinosus alone to the patella.

An excellent method of evaluating the end results is described in the article.

From the standpoint of muscle power it is believed that the patients eligible for reconstructive surgery are those who have sufficient residual muscle power to warrant the reasonable expectation that apparatus can be discarded postoperatively. Active co-operation on the part of the patient is essential for postoperative rehabilitation and mental inability to co-operate is therefore a contraindication to reconstructive surgery.

Fixed deformities such as flexion of the hip, flexion of the knee and equinus of the foot, must be corrected before hamstring transplantations.

The operative technique remains the same as that originally described by Crego and Fischer for transplantation of the biceps femoris alone. In transplantation of the biceps and semitendinosus simultaneously the additional procedure of detaching the semitendinosus from its insertion in the upper portion of the tibia and drawing the tendon out through an incision over the musculotendinous juncture of the semitendinosus on the posteromedial aspect of the thigh is carried out. The fascia of the muscle is split longitudinally toward its origin sufficiently to allow the tendon to be threaded forward through an oblique subcutaneous tunnel toward the patella. Care must be taken that the tunnel is directed in a gradually oblique direction toward the patella, and that the fascia of the muscle is opened sufficiently to allow a gradual oblique pull of the muscle on the patella, since a sharp angular pathway to the patella decreases the efficiency of the muscle pull. This principle is brought out in detail in the technique of biceps transplantation. The semitendinosus tendon is then anchored into the body of the patella.

It is important to stress the necessity for care in dissecting the biceps and semitendinosus tendons from their insertions since it is essential to preserve the tibial and fibular collateral ligaments intact.

Upon completion of the operation the extremity is immobilized in plaster of paris from the groin to the

toes, with the knee in from 175 to 180 degrees of extension. Physiotherapy is begun between the third and fourth weeks after operation. Complete removal of plaster during the eighth week is followed by active flexion of the knee against gravity. As soon as sufficient power has been obtained to stabilize the knee in extension, the patient becomes ambulatory without braces. It is now believed that postoperative braces may favor rather than prevent the development of recurvatum.

Factors causing failure of the operative procedures were (1) lateral displacement of the patella (2) recurvatum (3) total failure of the transplant to function and (4) instability of the knee. The authors believe that the development of recurvatum will be kept to a minimum if (1) fair or better power is present in the gastrocnemius (2) postoperative hyperextension of the knee in plaster is avoided (3) equinus deformity is corrected before weight bearing is begun postoperatively (4) postoperative braces which will throw the knee into recurvatum are avoided and (5) diligent postoperative physical therapy to promote active flexion of the knee is carried out.

The following conclusions are given ( ) hamstring substitution for residual paralysis of the quadriceps muscles in poliomyelitis is a highly satisfactory operative procedure (2) simultaneous transplantation of the biceps femoris and semitendinosus to the patella is a much more satisfactory procedure and produces far better results than transplantation of the biceps alone

RUDOLPH S. KEMER, M.D.

**Intraepiphyseal Arthrodesis in the Treatment of Tuberculosis of the Knee in Children** (La résection intra-épiphyse dans le traitement de la tumeur blanche du genou chez l'enfant) PIERRE GHEOULT. *Lille chir.* 947: 1, 189.

Intraepiphyseal arthrodesis was first used by Syme and by Olier and was later discarded because of high mortality and frequent recurrences. In later years, and especially after 1923, conservative treatment of tuberculosis was adopted and "nonintervention therapy" was favored. The author favored resection of bone and arthrodesis as the operative treatment of choice.

Calve and Galland reported the results of conservative treatment of tuberculosis of the knee cure with restitutio ad integrum in 25 per cent of the cases, cure with ankylosis in 10 per cent, and cure with partial ankylosis and a tendency to flexion deformities in 65 per cent. Sorrel reported results on 272 cases: cure in 43 per cent of children ankylosis with good position in 30 per cent, and poor results with incomplete ankylosis in 30 per cent. It is generally agreed that "cure" does not exclude a recurrence in from 3 to 5 years.

A number of intra-articular juxta-articular and para-articular ankyloses of the knee and their disadvantages are enumerated. It is pointed out that in most arthrodeses all or part of the cartilage is left undisturbed.

Best results were obtained in children between the ages of 12 and 13 years. Operation is not done until 8 months have elapsed since the onset of the infection. The temperature must be normal for at least 3 months. Good results were observed in old cases in which healing would not occur and in cases in which ankylosis did not occur because of interposed cartilage also in cases of ankylosis in poor position.

The operation is contraindicated if there are acut draining sinuses, in generalized infection, in cases with multiple tuberculous lesions, sinuses, or early ankylosis and in cases in which the diagnosis is not definitely established.

The technique is as follows: under general anesthesia and with the use of a tourniquet around the thigh a large "U" incision is made about the patella and is carried down through the aponeurosis. The patellar tendon is sectioned. The knee is slowly flexed which severs all fibrous bands. After freshening up of the condyles, the tibial plateau and the posterior aspect of the patella, the ends of the epiphyses are resected with correction of any existing deformity. Sequestra and necrosis of the synovial membrane are removed. The wound is closed and a cast is applied with the knee in slight flexion.

Forty children were operated on by intraepiphyseal arthrodesis. Two died because of shock (operation was performed without a tourniquet). In each of 38 patients a good ankylosis was found 3 or 4 months postoperatively. Three patients developed genu recurvatum. There was some slight growth disturbance following this procedure which probably would have occurred even if the operation had not been carried out.

GEORGE L. REISS, M.D.

**Positive Pressure in Arthrodesis of the Knee Joint.** J. C. CHARNLEY. *J. Bone Surg.* 1948, 30-B: 478.

The method of arthrodesis of the tuberculous knee joint, described by Key in 1932, was utilized by the author in 15 consecutive cases. Clinical union was detected at the first inspection in from 12 days to 6 weeks after operation. By this method the total period of disability was reduced to 3 months. In 6 cases the operation was performed for old tuberculous disease of the knee joint with fibrous ankylosis in bad position, and in 9 cases for osteoarthritis. Three mechanical factors which might be responsible for this very early clinical union were examined: compression is believed to be the main factor, although fixation is also important. The technique used in these cases is as follows:

Under a tourniquet the skin is incised in the midline, and the patella is excised. The knee is flexed, and the bone ends are sawn in such a way as to give flat surfaces of cancellous bone which when opposed, leave the limb almost but not quite straight. The bone surfaces are held together by an assistant and the edges of the skin wound are temporarily approximated by one or two volsella. This enables two parallel Steinmann nails to be passed, one through the upper end of the tibia and one through the lower end of the femur without tension on the skin sur-

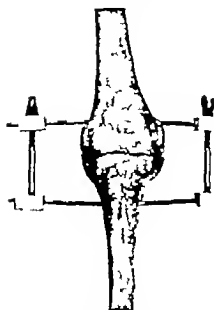


Fig. 1

Fig. 1 (Charnley) Arrangement of nails and clamps on femur and tibia. Note the coaptation.



Fig. 2

Fig. 2 Shows the "hairline" fit of the joint surfaces seen at operation.

rounding the nails when the wound is finally sutured. The nails are 4 mm. in diameter and 9 or 10 inches long. The projecting ends are connected by special screw clamps and the wing nuts are tightened until the nails bow under the compression force. In contrast to the postoperative technique utilized by Key in which the pins were incorporated in a plaster cast the author used a Thomas splint.

Arthrodesis of the knee joint by other methods may take an average time of 6 months, and there is an appreciable incidence of failure. The feature of this technique is the accuracy of timing which is possible. It is known precisely when bone union will occur. When compression is used in the manner described it may be predicted with certainty that the clamps can be removed after 4 weeks with the knee showing clinical union that union by bone will be present in eight weeks, as indicated by the absence of pain on straining the ankylosis and that the patient will be fit for re-employment by the end of the third month. Union takes place between two perfectly coapted surfaces of cancellous bone with intact circulation. Union of the arthrodesis is thus comparable to that of a fracture without displacement, under ideal conditions. Both the cut bone surfaces share actively in osteogenesis. By contrast, methods of arthrodesis which depend upon a bone graft seem illogical. Though it is customary to state that a bone graft can be used to combine the functions of internal fixation and osteogenic stimulation in actual fact a graft provides very imperfect fixation and cortical bone has less power of osteogenesis than the bones which it joins together.

The author indicates that bone grafts are capable of mechanical function in not less than 4 or 5 months. The graft is less osteogenic than the substance of the bones which form the joint and it provides inefficient internal fixation.

A theory is suggested that compression even in the presence of slight movement, acts by producing a fixed "hinge" without shearing movement at this point a bridge head of flexible osteoid tissue is established in which ossification inevitably takes place despite a slight bending movement. A second theory is suggested that high compression forces stimulate early union by liberating bone salts at points of maximum pressure through the action of osteoclasts and that the local excess of bone salts is redeposited under cellular activity within a range of a few millimeters where there is no pressure.

C. FRED GORRINGER, M.D.

**The Tendency Toward Conservatism in the Removal and Subsequent Reparative Surgery of Bone Tumors of the Articular Extremities at the Knee Joint** (Indirizzo di chirurgia conservativa e riparativa nei tumori ossei degli estremi articolari del ginocchio) G. GHERLINZONI. *Chir. org. movim.* 1948 31: 189.

Thirteen bone tumors of the juxta-articular bone ends at the knee joint are reported. These new growths included a giant cell tumor which had recurred after surgical removal, a myeloblastoma or immature giant cell tumor as distinguished from the less malignant mature giant cell tumor of Scaglietti, a sarcomatous metaplasia of a myeloblastoma, 5 myeloplastic sarcomas, 2 osteogenic sarcomas and 3 chondrosarcomas.

The Putti Juvvara operation was done in all of these patients. This consisted of the resection of the end of the affected bone followed by the turning upside down of a massive implant from the end of the apposed bone and intramedullary fixation in the usual manner. The other end of the implant was fixed to the surface of the parent bone with a circular ligature of catgut or of wire. The length of the

implant was kept down to between 15 and 18 cm even at the expense of shortening the extremity.

Consolidation of the implant was obtained in 8 of these cases following an average period of immobilization in plaster of 15 months. There was an average shortening of the limb of 3 cm. Pseudarthrosis developed in 3 instances. In 2 of these the faulty result was due to suppurative processes. In no case was the pseudarthrosis subjected to any further measures.

In 2 of the chondrosarcomas local recurrence developed and the limb was amputated. The patient with the sarcomatous metaplasia of the myeloblastoma and the 3 patients with osteogenic sarcoma, which was frankly malignant, have survived the operation, the one for 15 years and the other for 3 years. The patients with the immature giant cell tumor (myeloblastoma) the chondrosarcoma and the myeloplastic sarcoma died of visceral metastases in from 3 to 4 years following the operation.

The author believes that the results procured in this series of cases justify the present tendency toward conservatism in the surgical treatment of these conditions.

JOHN W BRENNAN, M.D.

**Arthrodesis of the Ankle Joint.** J. CRAWFORD ADAMS.  
*J Bone Surg* 1943, 30-B 306.

During the last 4 years, the technique of trans-fibular arthrodesis has been performed in 30 cases at a London Hospital. The author presents a case report, accompanied by 4 illustrations depicting the operative technique most adequately. The author's method of operation is as follows:

A 5 inch incision is made over the lower end of the fibula and the fibula is exposed subperiosteally. It is divided 3 to 4 inches from its lower end, removed from its bed, and prepared for an onlay graft by splitting off its entire inner cortex. The lower end of the tibial (lateral) bed is prepared by removing all soft tissues commensurate with the site of the onlay. The ankle joint is fully exposed. All available interarticular cartilage is removed until the foot rests in the optimal plantigrade position. The fibular graft is immobilized by three long transcortical screws, one of which grips the astragalus. The wound is closed. A plaster of paris cast is applied. Weight-bearing is encouraged after 3 weeks.

Because of its simplicity—adequate exposure, close contact of the onlay graft from the tibia clear across the joint and onto the astragalus—the operation is conducive to a formidable arthrodesis of the ankle joint. As an alternative procedure the author suggests the insertion of a three-flange nail from the os calcis into the shaft of the tibia.

SAMUEL L. GOVERMALL, M.D.

**The Surgical Treatment of Hallux Valgus (Il trattamento chirurgico dell'alluce valgo).** D. LOCARDINO.  
*Chir org movim* 1943, 31 8.

Sixty patients with hallux valgus were operated upon by various methods. In fact, it is considered that no one operation can be set up as a standard every

patient must be operated upon by a technique which is suitable to the particular conditions found. At the Rizzoli Institute in Bologna, Italy where this material was collected the operative correction by only those methods which involve the soft tissues have been largely abandoned and these techniques have been relegated to the position of occasional accompaniments to the skeletal procedures. This tendency may arise in part from the fact that the Rizzoli Institute tends to receive the more severe types of deformity, so that only the more radical procedures on the bones and joints affected would seem to offer assurance against recurrence.

In 16 patients the bony and articular changes were so severe that only an attempt at arthrodesis seemed indicated; however, this procedure should always be regarded as an ultimate refuge. In 4 instances the basal phalangeal bone was excised after the method of Abberg and the results were on the whole, satisfactory; however the author does not like to sacrifice this bone since its joint surfaces are usually intact and the method does not correct the spread of the first metatarsal which is the basis of the entire deformity.

On the whole the operation most commonly done in the moderately advanced conditions has been some form of osteotomy on the first metatarsal bone. In fact the author has himself developed an operative technique which he has not seen previously described and therefore describes it in considerable detail. His operation consists essentially in the usual approach for a cuneiform osteotomy of the head of the first metatarsal bone; however, when this has been accomplished a second incision is made over the proximal end of the first metatarsal and this bone is again osteotomized this time transversely. The cuneiform fragment is then implanted base side out into the new osteotomy tract, so as to throw the splayed first metatarsal toward the second metatarsal, from which position it has gradually diverged. Results from this operation in this type of case have been splendid, and photographs show the excellent cosmetic result procured. Of course, other procedures such as reshaping of the joint surface of the first metatarsal bone, capsuloplasty and even transplantation of the tendons, may be added.

A variation of the described operation has been worked out for cases in which the first metatarsal bone has become protruded forward which renders reduction of the deformity difficult. In this variant the cuneiform osteotomy is performed on the opposite surface of the first metatarsal, that is, the wedge of bone is removed from the lateral side of the bone down near its proximal end and thus the splayed distal end is more easily brought out to its normal position since the bone is shortened as well as abducted.

JOHN W BRENNAN, M.D.

**Bone Lengthening.** F. G. ALLAN, *J Bone Surg* 1943, 30-B 490.

Codivilla described the first bone lengthening operation in 1905. In 1913 Magnusson described his

experimental work on dogs and reported his performance of 14 such operations. Too rapid distraction on the Hawley table resulted in shock and death of one of the patients.

Abbott in 1927 described his own method as follows: osteotomy counter traction maintained by Steinmann pins above and below osteotomy tenotomy of tendo achillis insertion of drill pins circular division of the periosteum and deep fascia and the application of distraction apparatus.

Many modifications have since been advocated. Of particular interest, however are the contraindications issued therefrom. They are (1) loose control of hip and knee joints requiring permanent fixation (2) age (only adolescents and young adults are suitable patients), (3) lengthening greater than 3 inches, (4) recent joint or bone infection (5) very tall patients—shortening of long leg preferred.

The technique of lengthening of the tibia is that of an oblique osteotomy without circular stripping of the periosteum or fascia, and transverse osteotomy of the fibula at the same level as of the tibia. Two wires above and below the osteotomy are inserted in the tibia for the purpose of distraction the latter are tied to Kirschner stirrups which in turn are incorporated in the leg cast. Distraction is increased one-sixteenth of an inch a day until the desired length is achieved. Shock with undue pain is attributable to too rapid distraction with harmful tension on nerves muscles blood vessels and fascia or pressure on the skin overlying bony prominences.

Lengthening of the femur presents greater technical difficulty. Stiffness of the knee joint is a frequent concomitant. The author presents a report of 40 operations for lengthening the shaft of the femur in which he obtained an average lengthening of 1 3/4 inches with three failures.

Forty seven other operations were performed on the tibia and fibula in which an average lengthening of 2 3/4 inches was obtained with only one failure.

The average postoperative weight-bearing time was 5 months for the femur and 6 1/2 months for the tibia. Four and one third inches was the greatest lengthening achieved by this method. The reaction of bone to the operation was that of delayed union. All bones ultimately recovered their normal radiographic appearances. In 2 cases both leg bones became grossly decalcified.

The reaction of muscle to leg lengthening is adverse to its nutritional integrity i.e. too rapid lengthening interferes with the blood supply hence muscle wasting is inevitable. The lower leg is particularly vulnerable.

The reaction of the blood vessels during the lengthening operation is relatively innocuous. Their inherent elasticity allows considerable elongation in this adolescent group of patients.

The most vulnerable tissue reaction to leg lengthening is discernible in the nerves. Rapid sustained stretching is invariably associated with transient paralysis of the medial or lateral popliteal nerve. In the author's series the transient paresis of the

external or internal popliteal nerve was encountered 19 times or in about 22 per cent of the patients.

Joint stiffness in a mild form has been observed by the author.

In conclusion the author states that lengthening of 2 inches in the femur and 3 inches in the tibia can be achieved with relative impunity. Longer lengthening is obtainable with a high risk of transient paresis of the common peroneal nerve. Lengthening of the tibia is more feasible than lengthening of the femur. During traction lateral rigidity of the bony fragments is of paramount importance. In the opinion of the author osteotomy is best accomplished by closely spaced drill holes.

SAMUEL L. GOVERMAN, M.D.

## FRACTURES AND DISLOCATIONS

Statistical Considerations of 337 Shoulder Dislocations, Including Posterior Luxations and Nerve Complications (Consideraciones estadísticas sobre 337 luxaciones del hombro. Las luxaciones posteriores y las complicaciones nerviosas). JOSE MANUEL DEL SEIL. *Rev. ortop. traumat.* B. Air. 1948 17: 202.

This article is an analysis of 337 shoulder dislocations attended at the orthopedic department of the Manchester Royal Infirmary. Of the dislocations reported 8 per cent were of the recurrent type, 19 per cent had associated bone lesions, 18 per cent were posteriorly directed, 56 per cent sustained nerve complications, and 0.9 per cent disclosed some form of vascular injury. One of every 30 patients with dislocation developed deltoid paralysis. The frequency was approximately equal in both sexes, but showed a tendency to increase with age.

A plea is made for more thorough investigation of the entire shoulder musculature and meticulous testing of the nerves along with their dermatome and cutaneous distributions. It is believed that this alone will obviate any irreparable loss from atrophy or paralysis.

STEPHEN A. ZIEMAN, M.D.

Fracture Subluxations of the Shoulder. T. J. FAIRBANK. *J. Bone Surg.*, 1948 30-B: 454.

Among 115 cases of fracture of the upper end of the humerus, 12 patients were found to have a downward subluxation of the shoulder joint. Of these 11 patients had fractures of the humeral neck (7 of the abduction type and 4 of the adduction type) and the twelfth patient had a dislocation with fracture of the greater tuberosity. The ages of the patients varied from 24 to 82 years. In 6 cases subluxation was present when the patients were first seen; in the other 6 subluxation appeared several days or weeks later. This subluxation may have been due to the violence of the injury, to a weakness of the muscles which retain the humeral head in the glenoid, or to loss of tone in the longitudinal muscles of the scapula. Experimental investigations were carried out on normal shoulders and dissections and roentgenographic examinations were made in the postmortem room.



It was further shown that

1. All structures running down the arm from the shoulder including the vessels and the nerves, play some part in maintaining the stability of the joint.

2. If the whole rotator cuff is divided, the force necessary to subluxate the joint is only slightly diminished.

3. If all of the structures except the supraplatus are divided the force necessary to produce subluxation is very small.

4. The glenoid is too thin and pliable to have much of a stabilizing effect.

Experimental effusions into the joint cavity with air and water did not alter the stability of the joint significantly and it was found impossible to maintain any great tension because of the leakage under the subscapularis and down the long head of the biceps. A triangular sling for supporting the elbow prevents subluxation without interference with the fracture. With the aid of physical therapy muscle tone rapidly improves and recurrence is prevented. In cases in which a triangular sling is insufficient it may be necessary to place the arm in abduction and forward flexion by means of a plaster spica.

RICHARD J. BENNETT, M.D.

Fracture of Humerus. R. H. FREEMAN and M. D. LEVY  
*J Am M Ass* 1948, 37: 90

To determine the incidence and type of medical complications in patients with fracture of the hip, a survey of such patients treated at the Hospital for Special Surgery, New York, was made for the 10 years ending December 1946.

Seventy-two per cent of the patients were women mostly between 70 and 80 years of age. Significant postmenopausal osteoporosis and obesity were encountered and considered important etiological factors. Twenty-nine patients, or 17 per cent, had significant complications: there was pneumonia in 7 cases with 6 deaths and pulmonary infarction in 4 patients with 3 deaths.

Pre-existing diabetes, arteriosclerosis or hypertension did not endanger the patients per se but would have complicated any superimposed infection or vascular accident. The over-all mortality rate was 7.2 per cent, with most of the deaths occurring in women and in the older patients who were confined to bed.

Prevention of obesity would certainly lower the incidence of hip fracture and weight reduction should be prophylactically undertaken in all obese older persons. A curtailed caloric intake may be started as soon as the treatment of the fracture is begun. A daily intake of 800-calories is adequate for the bedridden patient and should include from 60 to 80 gm. of protein and plenty of low carbohydrate vegetable fiber.

The osteoporosis in this group of patients is not a disturbance of the calcium and phosphorus metabolism but is due to the insufficient production of osteoid tissue. Prophylactic estrogen or androgen therapy according to the plan of Albright is sug-

gested for persons whose osteoporosis is appreciable. Prolonged bed rest is contraindicated.

Pneumonia killed 6 of 7 patients with this complication in this series but antibiotics were not available in most cases. The second major complication phlebotrombosis was more frequent in bed patients than in the postsurgical patients. Anticoagulants were not employed in this group and might have favorably influenced the outcome.

Immediate care with regard to optimum nutrition, by parenteral administration if necessary and vigilance against the onset of complications to afford early definitive treatment are the major needs in providing adequate medical care for these patients.

FRANCIS E. BRIDGECOCK, M.D.

Results of Treatment of Fractures of the Hip. H. B. BORD and I. L. GEORGE. *J Am M Ass* 1948, 37: 90.

Fractures about the hip joint occur in 80 per cent of patients more than 60 years of age and chiefly in women (from 80 to 85%). Trochanteric fractures rarely end in nonunion for the blood supply to both fragments is adequate and much of the bone involved is cancellous. Conversely fractures of the femoral neck often cause loss of the blood supply to the proximal fragment and the area does not produce callus in any appreciable amount.

In trochanteric fractures the authors' mortality was 13 per cent, probably because of the greater trauma involved in the fracture and in its surgical reduction. However internal fixation with a Newfeld nail is their procedure of choice: this allows the patient early activity and reduces the mortality and the incidence of senile psychosis.

Statistics are offered on a series of 360 central fractures of the femoral neck of which 177 were followed up for more than a year. All deaths occurring within 4 weeks of operation were included in the mortality rate of 7 per cent. In the 100 patients under 70 years of age the mortality was 10 per cent but in older patients it rapidly rose to 42.0 per cent in the tenth decade.

Of the 177 patients followed up longer than a year 150 or 84.7 per cent obtained union, while 27 or 15.3 per cent suffered nonunion. In 23 of the 17 with nonunion reduction was inadequate but in the balance reduction was adequate and nailing was done. The shearing force in more vertical fracture lines is believed to have been adequately counteracted by good internal fixation.

Aseptic necrosis was seen in 31.6 per cent of the unions, and 59.3 per cent of the nonunions. Arthritic changes were markedly increased among the patients who were followed up for 1 year or longer. This included those in which definite collapse of the femoral head occurred in spite of union and disabled the patient as much or more than a nonunion would. Various operative procedures have been devised for the relief of this complication which now replaces nonunion as a major problem.

FRANCIS E. BRIDGECOCK, M.D.

**Fractures of the Acetabulum.** MARSHALL R. URIST.  
*Ann. Surg.*, 1948, 127: 1150.

The author reports on 58 injuries of the hip joint which occurred in jeep accidents. There were 16 cases of fracture of the acetabulum, of which 5 were fractures of the rim of the acetabulum, 3 of the superior and 2 of the posterior rim. There were 8 cases of central fracture and 3 cases of comminuted fracture, which disorganized the entire joint cavity.

It is shown that the posterior rim of the acetabulum is necessary for stability while the superior shelving portion is vital for weight bearing but the anterior rim may be excised without seriously altering the function of the joint.

Seven fractures of the acetabulum from the fracture service of the Massachusetts General Hospital were studied. At the end of 2 years, 11 of the 14 military patients had no serious disability. Displaced fractures of the superoposterior rim of the acetabulum appeared to produce more symptoms and disability than fractures of the anterior rim and central fractures. One unreduced fracture of the posterior rim caused severe pain and some limitation of motion, and on the other hand one patient whose joint was accurately repaired at open operation had a normal hip. The 3 patients with extensive fractures of the acetabulum and destruction of the joint cavity had ankylosis and complete disability. An open operation through an anterior iliofemoral approach is practicable in very severe cases.

RICHARD J. BENNETT JR., M.D.

**Fractures of the Ankle: Analytic Historical Survey as the Basis of New Experimental, Roentgenologic, and Clinical Investigations.** N. LAVER.  
*Arch. Surg.* 1948, 56: 259.

This is a historical survey of ankle fractures stressing the mechanism of fracture, the pathologic anatomy, the characteristic roentgen picture and the mechanism of reduction—genetic reduction. The subject matter is divided into three chronological periods: the clinical period, experimental period and roentgenographic period.

Under the clinical period the author discusses the recognition and treatment of ankle fractures from Hippocrates (about 300 B. C.) to Alexis Boyer (1803). During this period it became increasingly obvious that the fibular fracture is a very frequent, perhaps constant, complication in luxations of the talocrural joint.

Under the experimental period the author discusses the experiments of G. Dupuytren, Charles Bell, John Howship, Astley Cooper, I. G. Mason, M. T. Boyer and others. The chief advancement during this period was recognition of the fact that luxation of the talocrural joint is not only always accompanied by fracture of the lateral malleolus or of the fibula, but also is frequently accompanied by fracture of the medial malleolus and by diastasis between the tibia and fibula, and that several widely different forms of fracture of the ankle exist which according to experimental surgical investigations

are produced by varying mechanisms. Research on fractures involving the ankle by experimental surgery and autopsy came to a complete standstill with the introduction of roentgenographic diagnosis.

During the roentgenographic period the correctness of the conception formed in the experimental period has been borne out and it has been shown that fractures of the dorsal tip of the tibia are much more frequent than had been suspected, also that antero-lateral fracture of the tibia, and diastasis distally between the tibia and fibula are not at all rare. Attempts are made to develop and improve the methods of treatment gradually as knowledge and understanding of the various forms of fractures are increased, but in spite of the extensive application of roentgen examinations with a view to diagnosing the fractures of the ankle and exploring their nature the problem is far from having been solved.

From his survey the author concludes that (1) the exact genesis of most fractures of the ankle is still unknown, (2) the problem of the relationship between the marginal tibial fracture and the malleolar fractures, and between the former and rupture or detachment of syndesmosis ligaments has not been solved, (3) a sure knowledge of rupture or detachment of the ligaments of the syndesmosis in the various types of ankle fractures has not been reached, (4) the criteria of rupture or detachment of syndesmosis ligaments are uncertain, (5) the classification of the malleolar fractures in the literature is almost chaotic and (6) no attempts have been made to reduce the malleolar fractures in conformity with their actual nature.

In another article the author will present his study of roentgenograms from 229 patients in whom it was shown that it is possible to determine the origin (genesis) of all fractures of the ankle, their pathologic anatomy and their genetic roentgen diagnosis and by this means it was ascertained that the types of fractures of the ankle produced by experimental surgery correspond with 99 per cent of the clinical fractures.

JOHN J. CRANLEY JR., M.D.

## ORTHOPEDICS IN GENERAL

**Pneumarthrography of the Knee Joint with Particular Reference to the Semilunar Cartilages.**  
KJELD ANDERSEN. *Acta orthop. scand.*, 1948 Supp. 4.

In this monograph there is a comprehensive section on the history of arthrography and several good ones dealing with methods of joint injection, roentgenographic exposure and the pathological anatomy of torn semilunar cartilages.

The author gives an account of his experience with 129 patients who were examined by the method of Mohlmann and Madlener. 68 of these patients were submitted to operation. After correlating the arthrographic findings with what was seen at surgery he concludes: "It appears that not only all major changes, bucket handle fractures with dislocation of the torn part and partial longitudinal tears with dis-

location of the torn part were demonstrable with considerable accuracy but the minor changes total and partial longitudinal tears without dislocation could also be diagnosed in practically all cases.

H KELLERMAN, M.D.

**The Practical Importance of an Infrequently Occurring Anatomical Continuity between the Tibiofibular Articulation and the Knee Joint** (Importanza pratica di una non frequente continuità anatomica fra ginocchio articolazione tibio-peroneale) *Pediatrics* vol. xiv 948, 53 '26

Two patients were operated upon at the Centro Ortopedico e Mutilati di V. Putti in Bologna for apical osteomyelitis involving the leg previously amputated at the upper and lower thirds, respectively. Reamputation was performed in both cases.

In the first patient the fibula was sectioned very high and suppuration spread rapidly from the tibiofibular articulation to the knee joint. In the second patient postoperative recurrent hemorrhage occurred from ulceration of an artery several centimeters above the incision. It was therefore necessary to reopen the wound and subsequently to reamputate the thigh for an abscess at the head of the fibula.

In both of these instances the anomaly of anatomical continuity between the tibiofibular articulation and the knee joint was found which in the first patient developed into major clinical significance and in the second remained an incidental finding.

LESTER B. FARREWEATHER, M.D.

**Remarks on the Prognosis of the Posttraumatic Dystrophy of the Extremities.** *SVEN KROOK. Acta orthop. scand.* 948, 7 '25.

The author's article concerns 35 patients with posttraumatic dystrophy of the extremities, who were treated by sympathectomy. In 33 patients posttraumatic dystrophy posttraumatic osteoporosis, or hard edema characterized by pain, limited function, swelling, and joint and skin changes was observed. Of these 35 patients have recovered completely and permanently, 6 have a partial disability and 11 will continue to be markedly disabled. Of the remaining 3 patients, with moderate dystrophy, 2 have made a complete recovery.

The author believes that treatment should be instituted early, and he stresses repeated sympathetic block. In the present series of patients sympathectomy failed, however these cases were very severe or were of long standing. Ten of the patients presented a "nervous constitution" prior to the occurrence of the accident which was followed by dystrophy. DANIEL H. LEVINTHAL, M.D.

**Chronic Lesions of the Vertebral Column and Accidents of Work** (Lesiones crónicas de la columna vertebral y accidentes del trabajo) *TRONCOSO GERRAER W. Arch. Soc. cir. hosp. Santiago* 947, 7 '25.

The author reports on 3 cases in which his opinion was requested. In the first, a coal miner aged 61

was struck on the back by a mass of debris and suffered a fracture of the eleventh thoracic vertebra. Because of persistent pain and kyphosis, an Albee bone graft was inserted but had to be removed 3 months later on account of infection. Twenty two months after the accident the patient was allowed a 7 per cent disability. The author found a chronic deforming spondylitis of the entire spine.

Spondylitis is due to a pathologic change of the intervertebral discs which because of constitutional factors or degenerative processes lose their elasticity and normal height as age increases. A single trauma never causes it, and it is practically a normal manifestation in workmen more than 50 years of age. In vertebral fracture with lesion of the disc, marginal osteophytes usually develop after 4 to 6 weeks, especially on the anterior aspect of the vertebra, and unite two neighboring vertebral bridges. These formations are always limited to two or three vertebrae and have nothing to do with spondylitis. A spondylitic spine is more fragile than normal because its resistance is decreased by osteoporosis and loss of elasticity of the discs. Its spondylitic marginal formations may fracture because occasionally they are so close together on account of the decrease in height of the discs, that they easily touch one another on forced flexion of the spine. Rest, massage and gymnastics cure most cases by callus formation in 3 or 5 months but even if a pseudarthrosis forms healing should not take more than 6 months. Whatever disturbances are then left are due to the chronic deforming spondylitis. To accept or reject an aggravation of a spondylitis by an accident is always a difficult problem for the expert when there are no clear signs of injury. Even when it is certain that the pain and functional disturbances of the spine have appeared for the first time on the occasion of the accident, it is not possible to incriminate the latter for something that had to occur unavoidably in the natural course of the disease. Gausele has summarized the problem as follows: there is no traumatic spondylitis, whether localized or generalized deforming spondylitis is the expression of a disease of the discs and not a traumatic change; there is no aggravation of deforming spondylitis by a compensable accident nor by a vertebral fracture.

In the second case, a coal miner also aged 42 was struck to the ground by a falling mass of coal and was treated with a cast for fracture of the iliac crest and of the first and second lumbar vertebrae. The cast was removed in 4 months. At the end of one year he was allowed 50 per cent incapacity. The author examined him 13 months after the accident and found no trace of previous fracture but a congenital anomaly with six lumbar vertebrae, spondylolisthesis lateral inclination of the last lumbar vertebra on the base of the sacrum, and scoliosis of small radius with deformation of the vertebral bodies and discs through adaptation which could occur only during growth.

Spondylolisthesis is caused by an anomaly of vertebral growth at the level of the arches. Once estab-

Isbed it results in severe disturbances of the lumbago type which usually appear about the age of 30 and increase with age and may be associated with disturbances of the sciatic type canal symptoms (paresthesias paresis paralysis) stiffness of the lumbar spine inability to do hard work, and a swaying gait. All these disturbances may be minor slightly developed or very evident according to the degree of the disease. The patient is generally a constitutionally weak individual who should not earn his living by hard work like that of a coal miner. The present patient had paresthetic alterations in the lower extremity which were attributed to medullary involvement caused by the accident, but which were exclusively due to his vertebral anomaly that irritated the spinal nerve roots at their exits from the narrowed foramina.

RICHARD KEMMEL, M.D.

**The Value of the Faradocutaneous Sign of Hyperalgesia about the Paravertebral Region** (Valore semeiologico della iperalgesia farado-cutanea della regione paravertebrale) VINCENZO NERI. *Chir. org. movim.*, 1947 31 72

The author presents another diagnostic measure that is useful in differentiating spinal lesions. Faradic cutaneous stimulation eliciting hyperalgesia of the corresponding dermatome is employed. Direct manual pressure often gives a negative response and affords no clue as to the underlying pathologic change. The paravertebral area between the nape of the neck and the sacral groove is investigated. Like the rectus abdominis muscles, the erector spinae muscles manifest metameric innervation by the posterior branches of the spinal nerves. Because of this type of innervation one can recognize

changes in response to the electric current limited to that section of muscle that is solely innervated by one posterior branch of the spinal nerve.

The cathode is placed in the paravertebral region and slowly moved down the length of the spinal cord i.e., the vertebral column from the nape of the neck to the sacral area. The potential or quantity of current does not provoke pain. The subjective reaction is one of formication. When the cathode is placed over certain areas which are insensible to pressure sensations pain is elicited. This pain however does not register in the galvanometer reading. The area in which pain is elicited follows the distribution of the nerve as manifested by metameric innervation.

The author refers to many cases in which the afore-mentioned test was of great value. In many cases the sensation felt by the patient resembled a sudden sharp bite. The zone of hyperalgesia was distinctly limited both superiorly and inferiorly. The dermatome, which was hyperalgesic, corresponded exactly to the specific spinal root. This sign was valuable in the differential diagnosis of lesions of the cauda equina from those of the conus.

The faradic cutaneous hyperesthesia is also of value in early diagnosis of herniation of intervertebral discs and Pott's disease. In cases of compression in which the lipiodol does not reveal changes in the spinal canal this test is also useful.

The author waited for 4 years before he published his results correlating the operative and roentgenographic results with those found by this method. He controlled the method by proving that once the compression was removed, the area of hyperalgesia disappeared.

JOSEPH P. CAMINO, M.D.

# SURGERY OF THE BLOOD AND LYMPH SYSTEMS

## BLOOD VESSELS

Tonosclilography After Exercise. Боряк Епур *Acta med. scand.*, 945, 30: Supp. 1.

Tonosclilography is the simultaneous automatic recording of the absolute blood pressure (ton) and the deflections showing the magnitude of the pulsatory pressure variations in the artery of the extremity (oscillography). These latter deflections as observed in the conventional Pachon type of oscillogram are widely used in the examination for peripheral vascular disease. The author's newly designed ink recording apparatus registers the systolic and diastolic blood pressures on a vertical curve between each tracing of the pulse variation in the vessel. At 30 second intervals the pressure curves fall to zero and follow each other on an endless paper band. A standard type of blood pressure cuff is used at different sites on the extremity. Other types of oscillograms and tonosclilometers are briefly described and discussed.

Oscillogram and oscillographic examinations of the resting extremity have been employed previously in studying peripheral vascular disorders but "this is the first time that the method has been used routinely on the exercised extremity." Various forms of graded exercises affected the oscillographic curves obtained from both normal individuals (77 cases) and patients with peripheral circulatory disease (660 cases). After exercise the pulsations and blood pressure were increased in the normal extremity and decreased in the extremity with organic occlusive disease.

The significant features of the tonosclilographs are (1) the change in blood pressure and the type and amplitude of the oscillations (2) the gradual subsidence of the reaction to exercise and (3) the length of time of the recovery phase. In all cases with peripheral organic vascular changes the recovery phase exceeded a minute, and in many cases it lasted as long as from 15 to 30 minutes. This recovery phase seemed to be directly proportional to the severity of the total mechanical vascular obstruction. Intermittent claudication is "always attended by vasoconstriction peripheral to the arterial obstruction and is probably passive or secondary to the fall in blood pressure and not due to a special tendency to spasm. This will affect directly the capidity of the recovery phase. There was no difference in the curves obtained from patients with arteriosclerosis and those with thromboangiitis obliterans. Included in the pathologic material were 38 cases of coarctation of the aorta examined both before and after resection of the coarctation, 5 cases of pseudomalignoma elasticum, and 9 cases of Raynaud's phenomenon.

The results of exercise oscillography agree with the arteriographically confirmed organic changes in

the artery. Other tests used for evaluation of the peripheral circulation were measurement of skin temperatures after heating of the body after reactive hyperemia following injections of tetra-ethylammonium bromide after local blocking of the lumbar sympathetic chain or spinal anesthesia, and the determination of circulation time with fluorescein. From this exhaustive study of 3,000 oscillographic examinations the author concludes that "tonosclilography after exercise" is a "new method for early diagnosis of organic disease leading to intermittent claudication and for differential diagnosis of organic and functional arterial disease."

This translated monograph of almost 300 pages is well written and the material is well organized and indexed. An extensive reference bibliography, many graphs, tables and case reports are used throughout the text. The report is exceptionally complete. For clinical application it is doubtful whether the results of tonosclilographic studies of peripheral vascular disease which require expensive special apparatus are of greater value than the results obtained by experienced examination with more simple conventional oscillogram and other tests which are used today.

FRANK V. TRIM, M.D.

## BLOOD; TRANSFUSION

Hemolytic Transfusion Reactions. MORRIS J. WOLKOFF. *Anesthesiology* 948, 6: 345.

The development of blood banks has made the use of whole (citrate) blood transfusions a rather commonplace hospital procedure. And, as indicated by the author, although a compatible transfusion may often be lifesaving, an incompatible one may cause death. The purpose of this article is to review the etiology, signs, symptoms, prognosis, and treatment of hemolytic transfusion reactions, and present the experience of the Laker Clinic with 3 such reactions. In Table I the author states the common indications for transfusion.

Although many errors related to grouping and cross-matching of the donor and recipient can be made, which result in the patient's receiving incompatible blood, in the author's experience clerical

### TABLE I.—INDICATIONS FOR TRANSFUSIONS

1. Increase oxygen-carrying capacity hemorrhage, anemia, polycythemia
2. Restore blood volume in prevention or treatment of shock
3. Restore clotting mechanism to normal
  - A. Hypoprothrombinemia
  - B. Hemophilia
  - C. Platelets and other blood clotting elements
4. Correct hypoproteinemia, liver disease, nephritis, uric aciduria, carcinoma of stomach
5. Supply immune bodies in treatment of infectious diseases, septicemia, bacteremia, puerperal sepsis

TABLE II.—SOURCE OF ERROR IN BLOOD TRANSFUSIONS

- I Errors in grouping and cross matching
  - A. False negative reactions—weak typing sera
    - 1 Low titer from outset
    - 2 Deterioration from improper storage
    - 3 Deterioration from bacterial contamination
  - B False positive reactions
    - 1 Pseudo-agglutination (rouleaux formation)
    - 2 Auto-agglutination
      - a. Cold agglutinins act on all bloods
      - b. Warm agglutinins
    - 3 Iso-agglutination—cold iso-agglutinins act only on certain blood
- II Clerical errors in handling of blood at bank
  - A. Incorrect labelling of pilot tube
  - B. Wrong blood released from bank
  - C. Mix-up in administering blood to patients

errors have caused the greatest number of hemolytic transfusion reactions. Table II lists the sources of error that one is apt to encounter in the administration of blood transfusions.

A conscious patient who receives incompatible blood may show subjective signs and symptoms almost immediately or the reaction may be delayed and the initial manifestations develop several hours after completion of the transfusion. When incompatible blood is given to a patient under general anesthesia, however, there are no signs and symptoms to indicate what has happened unless by chance one should examine the urine and discover it to contain precipitated hemoglobin. In Table III the author classifies the various types of transfusion reactions.

Once it is established that the reaction is caused by the recipient's having received incompatible blood vigorous treatment should be started at once. The author lays particular emphasis upon the fact that a preconceived plan of investigation should be immediately invoked to afford early diagnosis and prompt treatment.

Although urinary alkalization has not proved a panacea, the author favors its immediate institution

TABLE III.—CLASSIFICATION OF TRANSFUSION REACTIONS

- I. Physical and chemical reactions
  - A. Chemical
    - 1 Foreign material in apparatus
    - 2 Pyrogens
    - 3 Coagulative changes in transfused blood
  - B Physical
    - 1 Rapid administration of cold blood
    - 2 Air embolism
    - 3 Pulmonary edema from too rapid administration
- II. Allergic or urticarial reaction
- III. Hemolytic reactions (Intravascular agglutination and hemolysis)
  - A. Intra-group type
    - 1 Rh factor
  - 2 "Cold hemagglutinins"
 

$\left\{ \begin{array}{l} \text{cirrhosis of liver} \\ \text{acute infectious} \\ \text{—virus pneumonia, paroxysmal cold hemoglobinuria} \end{array} \right.$
  - B Gross incompatibility
  - C. Dangerous "universal" group "O" donor
- IV. Transmission of disease—malaria, syphilis, infectious hepatitis

by the administration of sodium bicarbonate or potassium citrate orally or sodium bicarbonate sodium racemic lactate or sodium citrate intravenously. The fluid balance should be carefully watched and the retransfusion of compatible blood is important to counteract the severe hemolytic anemia associated with these reactions.

A new mode of treatment making use of A and B group specific substances to neutralize the alpha and beta agglutinins is discussed. If applied within the first few hours it may prove to be a most beneficial therapeutic endeavor.

Three cases of hemolytic transfusion reaction with anuria and hemoglobinuria are reported by the author. Two patients died and the third recovered. In the latter case 40 c.c. of Witelsky's A and B specific substances were given intravenously in addition to the usual therapeutic measures.

EDWARD F. LEWISON, M.D.

# SURGICAL TECHNIQUE

## ANTISEPTIC SURGERY; TREATMENT OF WOUNDS AND INFECTIONS

Infections of the Hand J. B. Loomis, J. D. Moxley and J. C. Scott *J. Bone Surg.* 1948, 30-B: 409

The authors present a study of 723 patients with infections of the hand, who attended the Casualty Department of Radcliffe Infirmary Oxford England. Their cases have been classified in accordance with the anatomical structures and spaces of the hand, and attention is called to the economic importance of infections of the hand and the high loss of man-hours.

All infections of the fingers and hand have been classified according to the degree of infection. Infections of first degree presented throbbing and tenderness; second degree infections presented more marked pain, redness, swelling, heat, tenderness, and fluctuation; third degree infections presented pain, redness, swelling, fluctuation, heat, tenderness, and devitalized skin; fourth degree infections presented the discharging hand; pain was not so marked but slough was present.

In 50 per cent of a series of 60 cases, no history of injury was given and it was deduced that the localized infection was blood borne. This conclusion seems most speculative since it is well known that small unnoticed abrasions of the hand are the most common progenitors of serious infections to follow.

The authors present a short description of the bacteriology and pathology of infections of the hand. They have also given an outline of the aims of treatment and the methods employed. Principles of treatment are based upon (1) the evacuation of pus, (2) excision of necrotic tissue, (3) primary suture of the wound whenever possible and in cases in which immediate skin coverage is not possible, early skin grafting. The operation is performed in a bloodless field. Dressings are changed infrequently and the involved part is immobilized in plaster. Two diagrams are presented—one showing incisions in relation to skin creases, the other showing incisions in relation to the underlying structures. These incisions, with the exception of incisions for drainage of a thenar space abscess, are essentially the same as those described by other authors. The preoperative, operative and postoperative treatment are discussed as well as some of the individual cases, with photographs taken before and after surgery.

Emphasis is placed upon the well recognized benefit of rest of the involved parts by complete immobilization. In all instances, appropriate amounts of penicillin was given. The various stages of acute tenosynovitis are discussed, and methods of treatment are described. In Table 3 the authors show the average time of healing of pulp space infections, distal palmar pulp infections, tendon sheath infections and paronychia.

The closure of infected wounds, after excision of necrotic and nonviable tissue is a radical departure from accepted surgical measures. This method of treatment of infections of the hand is believed to be radical and fraught with danger in the hands of the casual operator. MORRIS J. DIETRICH, M.D.

Streptomycin in Surgical Infections—Infections of Soft Tissues. EDWIN J. PULASKI, FRANK W. SPICKER, JR., AND MELVIN J. JOHNSON. *Ann. Surg.* 1948, 128: 46

This report, the fifth of a series dealing with the streptomycin therapy of surgical infections in United States Army hospitals is concerned with the results of this form of antibiotic therapy in infections of the soft tissues. Included in this report are 67 cases of cellulitis, 33 of which were associated with abscess formation, 30 cases of localized infection and 5 cases of specialized infection. Sixty-eight of the 102 patients were treated with streptomycin alone and 34 were treated with a combination of streptomycin and other bacteriostatic agents. Gram-positive cocci were the dominant organisms in 61 of the 102 cases. The *Staphylococcus aureus* and hemolytic streptococci were found in pure culture alone or in combination in 30 cases, and gram-negative bacilli were cultured alone in 16 cases. Mixed infections were present in 20 cases. Streptomycin was the only antibacterial agent employed in the treatment of 63 cases, the results being classified as good in 47, doubtful in 7, and poor in 14. The results in 34 cases treated with streptomycin in combination with penicillin or sulfadiazine, or both, were good in 24 cases, doubtful in 4, and poor in 16. No reaction to streptomycin occurred in patients receiving less than a gm. of the drug daily, and only 8 of the 61 treated patients had minor undesirable effects of dizziness, nausea, or vertigo when this dose was exceeded.

The authors state that good results cannot be expected from streptomycin therapy unless certain conditions are met: the organism or organisms responsible for the infection must be streptomycin-sensitive; the drug must be given in adequate dosages; there must be little or no necrotic tissue present and the blood supply to the affected site must be adequate. The cases in this series in which poor results followed streptomycin therapy were almost without exception cases in which these principles laid down by the authors were violated. Streptomycin apparently has its chief field of usefulness in acute infections complicated by cellulitis. It also has a field of usefulness in the therapy of acute gram-positive coccal cellulitis which are penicillin-resistant in which the patient has developed a penicillin-analitic reaction or in mixed infections in which the response to penicillin alone is not satisfactory because some organisms present are not penicillin-sensitive. Streptomycin applied topically gave indiffer-

ent results and it is concluded that if local wound suppuration is not completely controlled within 72 hours after the topical application of streptomycin is begun the effect is probably not bacteriostatic. When streptomycin is used it must be given in adequate dosage. The optimal dose when it is used alone is from 2 to 3 gm daily the duration of treatment depending on the response. If treatment is discontinued too soon after a favorable response is apparent recurrence is likely. On the other hand if therapy must be continued longer than 14 days, the dosage should be reduced to avoid the risk of labyrinthine disturbances. The optimum dosage of streptomycin in combination with penicillin has not been worked out yet, but from present indications it will be considerably less than 2 to 3 gm daily now regarded as optimum when streptomycin is used alone.

EDMUND A. GORVETT, M.D.

### ANESTHESIA

**Sacrococcygeal Epidural Anesthesia in Obstetrical Practice** (*L'anesthésie épidurale sacrococcygienne dans la pratique obstétricale*) HENRI DREUDONX, *Anesthésie Par* 1947 6 166

In succession, the author discusses the history of sacral anesthesia, its field of application, principle of action, technique, physiological action and the indications and contraindications to its use.

The principle of epidural anesthesia consists in a physiological interruption of nerve impulses conducted by the sacral nerves which innervate the soft tissues involved, i.e. the perineum, vulva, vagina, and the ischioanal fossae. By its application there is obtained an analgesia of the anus, rectum and urethra, as well as the parts above mentioned. The uterine body seems to escape anesthesia while anesthesia of the cervix is not constant.

The technique employed by the author is as follows: with the use of a blunt needle and with trocar in place, a puncture is made through the sacrococcygeal hiatus in the usual manner. The trocar is then withdrawn and a urethral catheter the same caliber as that of the trocar is introduced through the lumen of the needle and cautiously slipped into place. The distal end of the catheter is transfixed to the skin with adhesive tape. By means of a syringe led into the outer end of the catheter, 25 c.c. of 1.5 per cent procaine is injected. The syringe is then replaced by a graduated container holding from 20 to 30 c.c. of the same anesthetic, which is allowed to flow into the catheter drop by drop as needed.

The physiologic effect of the anesthetic occurs in from 20 to 30 minutes from the time of the injection and lasts from 1½ to 2 hours. Two actions are produced. The first of these is a constant action produced on the anus, vulva, perineum and vagina which is evidenced by a state of anesthesia, relaxation and decrease in turgidity of these parts. A less constant action produced is that of anesthesia of the vault of the vagina, the cervix and sometimes the body of the uterus.

The action on the uterine contractions in some cases is very marked, the amplitude is often greatly diminished, the rhythm less frequent and the contractions may sometimes entirely cease. In some cases the cessation of uterine contractions has been accompanied by varying degrees of uterine hemorrhage.

Action on the perineum is shown by an easy dilatation of the vulvovaginal canal which lessens the chance of perineal tears in cases in which the application of forceps is indicated.

With anesthesia of the perineum already obtained it is easy to suture perineal tears which may have occurred.

The author mentions several causes of failure to obtain epidural anesthesia. Failure to locate the sacrococcygeal hiatus may be due to the presence of an abnormal amount of subcutaneous fat in obese patients, to a deformity of the sacrum or the sacral canal as in spina bifida, to partial or total ossification of the membrane of Cathelin, or to a deformity of the upper end of the coccyx. Technical failure will result when the needle has not been introduced into the right place.

This type of anesthesia is indicated in cases of abnormal delivery, such as breech delivery in primiparas in whom versions or other operative maneuvers are indicated, proper relaxation of the soft tissues is afforded in such cases. It is indicated in cases in which spinal anesthesia is contraindicated as in cardiac and pulmonary complications or in long drawn out deliveries in which general anesthesia would prove fatal.

When epidural anesthesia retards labor by reducing uterine contractions, pituitary injections may be given to obviate the difficulty.

The length of time which elapses between the injection of the anesthetic and the attainment of satisfactory anesthesia contraindicates its use in those cases in which prompt anesthesia is demanded as for example where danger to the life of the fetus exists.

BLACKWELL MARSHAM, M.D.

**One Year's Experience with Intravenous Procaine**  
DAVID J. GRAUBARD, R. W. ROBERTAZZI and MILTON C. PETERSON, *Current Res. Anesth.*, 1945, 27 222

The authors report further on the clinical use of the intravenous administration of procaine for the relief of pain in 448 instances of traumatic, inflammatory and various other disease entities. The solution was prepared as a 0.1 per cent solution of procaine hydrochloride in isotonic saline solution to which has been added 1 gram of sodium ascorbate per 1,000 c.c. of solution. The average patient was observed to tolerate procaine better when given intravenously with vitamin C. A standard dosage of 4 mgm of procaine per kilogram of body weight in 20 minutes was used for each infusion.

The signs and symptoms observed during the intravenous administration of procaine were a sensation of warmth throughout the body sometimes ac-



accompanied by a flush over the head face and neck and followed by dryness of the mouth, a metallic taste, lacrimation, dilatation of the pupils, and light-headedness. Increasing the rate of flow or the concentration of procaine resulted in the manifestation of apprehension, dizziness, the sensation of trembling and sleepiness.

The types of cases in which this procedure was used as an adjunct to management are briefly summarized. Uniformly good results were obtained in relieving the pain of trauma except in cases of herniated intervertebral disc and in cases of myalgia of the upper extremities or of the shoulder girdle. In general the inflammatory conditions responded well except for lack of benefit in 7 cases of tic douloureux. Other conditions, including malignant disease and multiple sclerosis, varied considerably in response to the intravenous administration of procaine. However one case of established Parkinson's disease is reported with almost complete absence of tremors after 6 infusions over a 3 week period.

MARY KARP M.D.

*d*-Tubocurarine Chloride T. CYCIL GRAY *Proc. R. Soc. M. Lond.* 948, 4 559

The article is a critical appraisal of *d*-tubocurarine chloride in the light of 3 years experience with its use in anesthesia. This is one of the least toxic drugs used in anesthesia as the heart, liver and the kidneys are unaffected by it. Nevertheless it is potentially one of the most dangerous. Any dose likely to be of service to the anesthetist will affect the respiratory muscles to some extent.

Certain points of technique are stressed. First and most important is the necessity to aid or assist respiration when *d*-tubocurarine has been given. A preliminary small dose as a test is strongly advocated. Intubation is carried out frequently to obviate the hazard of regurgitation of the stomach contents and to prevent inflation of the stomach.

It is the clinical impression that patients who have been anesthetized with the help of *d*-tubocurarine suffer less from shock than those who are subjected to deep or moderately deep anesthesia. The good

postoperative condition of the majority of these patients is accounted for by the fact that their vasomotor compensatory mechanisms are still active after a light anesthesia.

The author believes that *d*-tubocurarine is not the final answer but the absolute certainty of the results, its comparative nontoxicity and the ease of anesthesia in which it is used are factors which indicate a most significant step in management.

MARY FRANCES POE, M.D.

The Vasodilating Action of Some Local Anesthetics.

R. BEUMER. *Current Res. Anesth.*, 943, 37-197

The author discusses the fall of the blood pressure in spinal anesthesia. Fourteen dogs were studied, the blood pressure being registered in the usual way through a cannula inserted in the carotid and connected with a mercury manometer registered on a smoked drum. A dose of from 5 to 10 mgm. per kilogram of procaine was injected intravenously and the effects were noted.

The results demonstrated that the fall of the blood pressure is the result of vasodilatation which manifests itself in the free bleeding of the procaine injected areas following incisions or trauma. In an attempt to study the clinical structure with regard to this vasodilatation effect a number of other local anesthetics were studied and varying doses of these drugs were injected intravenously.

According to the observations made nearly all local anesthetics were found to lower the blood pressure by peripheral vasodilatation. The degree of this dilatation varied according to the chemical structure of these drugs without relation to their anesthetic potency. Intracaine was found to lower the blood pressure most, monacaine the least, and procaine and apothesine lowered it to a middle position. Cocaine was found to be the only local anesthetic which in no case produced a fall in the blood pressure. In no instance was a material change in the rate or stroke volume of the heart observed, thus, the presence of cardiac depression was not considered the cause of a lower blood pressure.

MARY KARP M.D.

# PHYSICO-CHEMICAL METHODS IN SURGERY

## ROENTGENOLOGY

The General Theory of Stratigraphy (Teoria generale della stratigrafia) ALDO PERUSSIA AND CARLO BROCCI *Radiol. med.*, Milano 1948 34 449.

The characteristics of various modalities of stratigraphic examinations depend entirely on the theoretical study of the involved geometric problems.

The authors attempted to express in geometric terms the optimal relations between the focus, the object and the film. The various modalities of the stratigraphic method may be reduced to a single geometric formula which has been developed by the authors.

The stratigraphic method is especially adaptable to the study of the cranium, facial bones, the larynx and the chest.

The question arises: Is it possible by a proper selection of the position of the focus-object film to visualize a single layer of the object? In geometric terms the same question could be formulated as follows: What relations should there be between the focus and the film to retain the projection of the focus on the film during the movements of the system? It is this question that the authors attempted to answer by developing their geometric formula.

JOSEPH K. NARAT M.D.

Two Cases of Vertebra Eburnea of Apparently Primary Origin (Due casi di vertebra eburnea apparentemente primitiva) GIUSEPPE LISCHE *Radiol. med.*, Milano 1948 34 385.

The term vertebra eburnea is applied to a sclerotic process involving chiefly the body of the vertebrae and producing a variety of symptoms. Three groups of the lesion may be differentiated:

1. Opaque vertebrae of neoplastic origin. In descending order of frequency the following tumors may produce osteoplastic metastases: carcinoma of the prostatic gland, epithelioma of the breast, especially the scirrhous cancer of the stomach or the colon, hypernephroma and primary osteoblastic sarcoma of the spine. A contiguity of a neoplastic process may produce an opaque vertebra.

2. Opaque vertebrae caused by local or general pathologic conditions such as malignant lymphogranulomatosis, Paget's disease, blood diseases with osteosclerosis, syphilitic spondylitis, tuberculous spondylitis, streptococcal osteomyelitis and Kummell-Verneuil's syndrome.

3. Opaque vertebrae which apparently have no relation to any other pathologic process.

Two cases belonging to the last group are reported by the author. The first patient, a woman 58 years of age, was afflicted with complaints of pains in the right upper quadrant of the abdomen. An eburnation of the first lumbar vertebra was found in addition to spondylarthrosis of the second and third

lumbar vertebrae. The rarity of opaque vertebrae on one hand, and the great frequency of arthritic conditions of the spine on the other made relations between both conditions highly improbable.

Some nutritional disturbances affecting the calcium and phosphorus metabolism, avitaminosis or some toxic factors of exogenous or endogenous origin could have been responsible for the condition.

In the second patient, a woman aged 49, eburnation of the second lumbar vertebra was discovered in roentgenograms. The patient stated that she developed a sudden intensive pain in the lumbar region during parturition which took place 15 years prior to her admission to the hospital. Possibly the trauma caused a reflex in the sympathetic system with resulting vasodilatation and modifications of the local nutritional conditions.

JOSEPH K. NARAT M.D.

Some Considerations in the Treatment of Hemangioma in Infants and Young Children. EUGENE I. PENDERGRASS, JAMES C. KATTERJOHN AND JAMES B. BUTCHART *Am. J. Roentg.*, 1948 60 182.

The authors present their experience since 1938 in the treatment of 560 hemangiomas in 406 patients. The lesions had a wide distribution in location over the bodies of the patients.

Hemangioma of the skin or mucous membrane is a lesion familiar to every doctor. Whatever treatment is given should be early, that is, as soon after birth as possible or as soon as the blemish appears. A hemangioma is a localized hyperplasia of the cutaneous or subcutaneous vascular tissue. It varies in size and color. Vascular nevi may be separated on an anatomic basis into three groups: (1) flat or slightly elevated tumors composed of a superficial plexus of dilated capillaries, angioma simplex, nevus flammeus and port wine stain; (2) hypertrophic angiomas made up of an interlacing network of blood vessels of considerable size—angioma plexiforme and angioma simplex hyperplasticum and cavernous hemangiomas.

The technique employed may be divided into two parts: control of the superficial or dermal elements by roentgen therapy as the first part, and control of the deeper portions of the lesion by implantation of radon seeds or use of intermediate voltage therapy. The treatment is given over a period of months. When lesions occur on the scalp around the eyes or in the region of the epiphyseal center of a bone, the family is advised about the possibility of damage to these structures. For small lesions located either around the eye, the lips, the nose or the labia, the authors prefer to use the Phillips unit using 44 kv. In every other situation the Chaoul apparatus using 45 kv. is preferred. The number of portals used depends on the size of the lesion and its shape. The skin target distance depends upon the depth of the

lesion. In port wine stains, the Phillips unit with 1.9 cm. distance is used. In the deeper or thicker lesions from 3 to 5 cm. skin target distance is used with the Chaoul unit.

Intermediate voltage from 75 to 155 kv. is used in the instances in which the lesion is large and bulky. Most of the small and deep-seated hemangiomas are treated with radon after skin discoloration has been removed by roentgen therapy. With intermediate voltage from 1 to 3 mm. of aluminum filtration with a half value layer of from 2.4 to 4.6 mm. of aluminum is used the filtration of the radiation with the Phillips and Chaoul units ranges from unfiltered to 0.3 mm. of nickel. The half value layer of the radiation is 2.4 mm. of aluminum with the Chaoul apparatus, and 0.3 mm. of aluminum with the Phillips unit at contact. The lesion is given from 300 to 400 roentgens (as measured in air) through as many portals as are required to cover it. The portals do not overlap. The patients are seen at intervals of 4 to 6 weeks. Usually from 3 to 7 treatments are required and usually less than 1500 roentgens are given. Seventy five per cent of the patients treated with the Chaoul apparatus receive less than 1350 roentgens and 95 per cent receive less than 1750 roentgens the treatment time extending over a period of 18 months. The most deeply situated portions of the lesions are treated with implantation of radon seeds of from 0.1 to 0.5 mc. of strength through multiple portals. In general all lesions respond well if treated early.

FRANK L. HUNTER, M.D.

**Statistical, Pathogenetic, and Clinical Considerations on Radionecrosis of the Mandibular Bone** (Considerazioni statistiche, patogenetiche e cliniche sulla osteoradionecrosi mandibolare) FRANCO PIZZETTI. *Radiol. med. Milano*, 945, 341-351.

This study is based on 48 cases of bone necrosis observed among 153 oral carcinomas which were more or less connected with the mandibular gum were treated at the Institute of Radiology of the University of Milan, and had been followed up for a considerable period. The bone necrosis usually sets in suddenly months or years after radiotherapy is manifested clinically by severe pains, and is often preceded, sometimes accompanied or followed, by necrosis of the overlying soft tissues. It results in the formation of sequestra which are eliminated spontaneously or removed surgically. The course is prolonged for months and healing begins only after elimination of the sequestra. Some authors attribute the bone necrosis to the direct action of the rays on the living cells of the bone but most authors believe in a vascular pathogenesis in which the rays produce changes in the vessels of the bone or in those of the overlying periosteum and mucosa. Of the 48 cases, 38.5 per cent occurred between the ages of 40 and 70, and 65 per cent after the age of 70.

Two treatment methods were used the first consisted of intraoral radium therapy followed by the removal of involved lymph nodes and the application of an external radium apparatus providing from 30 to

40 U D the second consisted of intraoral radium therapy only.

Bone necrosis occurs rarely when the calculated dose remains below 1.4 destroyed millifarads per square centimeter (with or without external apparatus) but appears suddenly and frequently when this dose is exceeded. It occurs with about equal frequency with or without an external apparatus when the dose is between 1.4 and 2 mc. per square centimeter and it occurs constantly when the dose approaches 3 mc.

Eight cases were preceded by tooth extraction in the involved zone from 25 days to 12 months previously. In 2 of these cases the extraction was done for extraneous reasons and was soon followed by bone necrosis. In the other cases the chronologic relationship was rather close and the interval was marked by local dystrophic or inflammatory phenomena which gave the impression of a cause and effect connection. These patients had been given medium doses and one had received a particularly low dose. Twenty-seven cases were preceded by necrosis of the overlying gum often denuding the bone. The patients had received an average dose of 1.7 mc. Of the remaining 21 cases, 5 were preceded by dental extraction and 4 by inflammatory phenomena with fistula formation. In 12 the necrosis of the mucosa was present at the time of elimination or removal of the sequestrum the patients had received an average dose of 1.5 mc.

It is to be noted that bone necrosis has occurred 5 or 6 times less frequently when treatment consisted only of the application of an intraoral apparatus instead of the introduction of radium needles. This may be due to the fact that the needles are closer to the periosteum or produce more mechanical damage to the gingivoperiosteal vessels.

The following conclusions appear to be justified. The medium global dose of radium exerts a marked influence on the incidence of bone necrosis which is rare when the dose is below 1.4 mc., more frequent when the dose exceeds 1.4 mc., and exceedingly frequent when the dose approaches 3 mc. Needles inserted close to the surface of the bone especially those of high potency seem to exert a marked damaging effect on the vital ty of the bone. The adjunction of an external radium carrying apparatus, usually sub-mandibular does not seem to influence the incidence of bone necrosis.

RICHARD KEMEL, M.D.

**Laryngeal Chondronecrosis Following Roentgen Therapy** WILLIAM A. GOODRICH and MACKEY LEE. *Am. J. Roent.* 945, 60-62.

Healthy laryngeal cartilage is protected by a normal mucosa and the perichondrium will withstand infection with moderate fractionated x-ray dosage. However when adult cartilage is infected or traumatized extensive necrosis and sequestration may occur. Chondronecrosis is rather rare in small or early carcinoma. It is more common in advanced or extensive growths for the tumor invades the adjacent tissue and obstructs the venous and lymphatic capillary flow thereby causing mucosal edema. The edematous mucosa tends to ulcerate and affords

access of bacteria into deeper tissues. As a result of this spreading infection the perichondrium becomes involved with involvement of the cartilage. Such a process may occur with or without x ray therapy according to the extent of the lesion.

From 1932 to 1946 205 cases of laryngeal tumors were studied. There were 28 cases of laryngeal necrosis. The chondronecrosis was dependent upon the following factors: (1) the time interval between the last x ray treatment and the recurrence of the necrosis; (2) the site and extent of the involvement of the tumor; and (3) any previous surgery such as laryngectomy that has been done prior to the x ray therapy.

Chondronecrosis in the majority of cases (23) was observed within 6 months from the time of treatment if finished. Seventeen patients showed a fixation of the arytenoids which suggested that these may have been the initial site of the chondronecrosis. Thyroid cartilage necrosis did not appear to be the initial site in the present series of cases. Chondronecrosis was slightly more severe in the cases in which the epiglottis was involved. Most cases of cured cancer of the epiglottis showed a definite deformity of the cartilage which indicated a healed area of chondronecrosis. In the series of 25 patients with carcinoma of the epiglottis which had been treated 6 developed a marked necrosis of the cartilage.

The extensiveness of the lesion has a definite influence on the tumor. Chondronecrosis was observed in 16 cases in which the arytenoids were fixed. In 2 of 7 cases with laryngeal fissure chondronecrosis developed. There was 1 case in which hemilaryngectomy was done 2 weeks after a tumor dose of 7,800 roentgens was given. The removed portion of the larynx showed only radiation reaction without evidence of necrosis or persistent carcinoma. However after the operation chondronecrosis developed promptly in the remaining portion of the larynx. The second patient was subjected to partial bilateral removal of the thyroid cartilage before x ray therapy and developed a chondronecrosis of the remainder of the cartilage.

Laryngeal edema was apt to occur when larger fields a daily dose and a shorter period of treatment were used. The dosage given to the 28 patients who developed chondronecrosis was as follows: 14 received a tumor dose of from 5,500 to 6,000 roentgens and 10 were given a tumor dose of from 6,000 to 7,000 roentgens. The average effective tumor dose was between 5,500 and 8,000 roentgens. The treatment time in the majority of cases ranged from 35 to 45 days and the daily dose from 100 to 150 roentgens, which was given to two opposing laryngeal fields. In several cases in which there was marked edema prior to therapy the dosage was lowered to 50 roentgens and the size of the field was cut to about 6 by 8 cm. Patients with laryngeal carcinoma were generally given from 6,000 to 7,000 roentgens in air in a 6 week period to two lateral fields directed somewhat obliquely toward the larynx. Central

overlapping of radiation was avoided with a 1 cm lead strip a 200 kv unit was used 100 roentgens were given to each side the fields being 5 by 8 cm. each. If cervical nodes were present they were treated separately.

Reactions during the course of treatment varied. Treatment was usually interrupted between 1,400 and 1,800 roentgens to each of 2 fields if a pseudo-diphtheric membrane developed and was reannned after several days when the inflammation began to subside. The treatment was carried to completion if the initial membrane did not develop until 2,500 roentgens had been given to each field, i.e., approximately 3,000 roentgens to each field. Sometimes treatment had to be interrupted to allow the edema to subside and in some cases tracheotomy was done before treatment. In such instances the daily dose was much smaller generally between 50 and 75 roentgens.

The prognosis of chondronecrosis of the free portion of the epiglottis is much more favorable than that of the rest of the laryngeal cartilages, for any necrosis of the former portion can readily be expectorated. Arytenoid chondronecrosis has a bad prognosis with an upward drainage of infection and necrosis.

Chondronecrosis can be prevented to some extent by the extensive use of chemotherapy. In several instances of extensive carcinoma with marked infection chondronecrosis was prevented by the oral use of penicillin for several weeks prior to the treatment. It is quite possible that the Arbuckle procedure (total removal of the cartilage by laryngectomy) would be helpful. MARGARET D. SACNA, M.D.

**Radiology of the Persistent Thyroglossal Duct (Zur Roentgenologie des Ductus thyroglossus persistens).**  
W. GUNZERT *Acta radiol.*, Stockholm, 1948, 39, 343.

The author reviews the embryology and anatomy of the thyroglossal duct, discussing at length the development of the four main types: (1) incomplete duct with fistula communicating with the foramen cecum; (2) incomplete duct with exterior fistulous communication; (3) a complete median tract, with or without cystic formation; and (4) a cyst in a blind remnant of duct with neither exterior nor interior communication.

The roentgenologic diagnosis of these conditions is discussed. A differential diagnostic list is included and throughout the entire discussion an excellent list of references is given. Four case histories are given as diagnostic problems for roentgen study. The following suggestions are made regarding the diagnostic technique:

There are a large number of radiopaque media which can be used for injection into the tract, usually by means of a cannula among which are barium blismuth sodium iodide sodium bromide and the newer substances thiorastat and iodized oil. None of these contrast media are completely satisfactory at all times. When there is a complete median tract a more viscous medium must be used to prevent spilling out as quickly as it is injected. The site of injection

varies with the type of the persistent structure. In an incomplete inner fistula an injection of medium can be done through the foramen cecum. This is best done under pressure with a cannula because sometimes the fistula ends in a blind cyst filled with cholesterol crystals. Injection into an incomplete outer fistula is more simple and is done under some pressure to outline a terminal cyst. It is difficult to outline the complete median tract which is patent at both ends. One way of doing this is to inject from the exterior aspect sufficient medium to fill the tract and cyst, if present, so that the medium escapes through the foramen cecum. The patient will state that there is something in his throat at this point and a roentgenogram taken at the same time should show a completely filled tract. In the cases of cysts with neither outer nor inner fistulous opening a puncture is made in the midline with a sharp needle which is left in place after the injection and a roentgenogram is taken to check the actual filling of the cyst. One reference is given to x-ray and radium treatment of the thyroglossal duct.

JACK C. MACGILLIVRA 316

#### Angiocardiography in the Diagnosis of Congenital Heart Disease. K. D. KEELE. *Bull J Radiol* 94, 31-35.

The importance of accurate diagnosis in congenital heart disease has of recent years increased with the advent of surgical methods of treatment. Angiocardiography provides a method whereby this necessary accuracy may be obtained. In the present article acyanotic congenital heart disease only is discussed since it is considered that this group of cases presents most commonly the diagnostic difficulty in relation to surgical treatment.

The technique is outlined briefly. After preliminary sensitization tests the child is anesthetized with cyclopropane and oxygen by means of an intra-tracheal tube.

The patient is placed on a cassette tunnel in the anterior oblique position. A vein in the left antecubital fossa is dissected out and a large cannula is inserted. After a preliminary film from 15 to 20 c.c. of 70 per cent pyeloid is introduced within 2 seconds into the vein. Eight films are exposed in rapid succession in the next 12 seconds. Normal saline is infused through the cannula for the 15 to 20 minute period to aid in excreting the contrast agent. The procedure is repeated with the patient in the anteroposterior position. Films are taken at 65 kilovolts, 200 milliamperes and 1/20th second exposure.

The author presents the findings in a normal angiocardiogram. He also reports 5 cases of children presenting abnormal angiocardiograms, coarctation of the aorta, patent ductus arteriosus with complete heart block, patent ductus arteriosus with pulmonary stenosis, patent ductus arteriosus with patent interauricular septum and patent interventricular septum.

It is believed that angiocardiography should be used in any case of congenital heart disease in which operation is being considered since it may provide

proof of the suspected lesion and also reveal other lesions.

FRANK L. HURLEY M.D.

#### Radiation Therapy of Malignant Tumors of the Testis. T. LEUCUTIA, WILLIAM A. EVANS, JR., and JAMES C. COOK. *Radiology* 1945 51: 177

Review of the literature indicates the incidence of neoplasms of the testis to be between 0.5 and 1.5 per cent of all malignant neoplasms. The authors present a statistical analysis of the factors influencing the survival rate in 110 cases of malignant tumors of the testis observed at Harper Hospital, Detroit from 1923 to 1947. The patients were in most instances treated by simple orchiectomy followed by extensive irradiation, operation having been omitted only if external metastases were present.

Irradiation was started within a few days after the operation and applied not only to areas of regional invasion but also to areas of probable distant extension regardless of whether or not there was obvious evidence that metastases had already occurred. The treatments were grouped at from 8 to 10 week intervals. The first series included four or five portals for the pelvis and groin, three or four portals over the para-aortic lymph nodes, 2 for the supraclavicular and cervical nodes, and 2 portals for chorioepithelioma of the kail. In the second and third series of treatments only the pelvis and abdomen were irradiated. The portals were large and full doses were delivered in a single session per portal, at the rate of one portal per day. The factors used were usually 200 kV, half aluminum layer 1.0 mm of copper, 50 cm. skin target distance, intensity 15-20 roentgens/min. The full dose amounted to 100 per cent SUD for the first series, 90 per cent for the second, and 80 per cent for the third, with 100 per cent SUD set at 525 roentgens in air (785 roentgens with backscatter). In some heavy patients the factors chosen were 300 kV, 7 mm. of copper, 60 cm. skin-target distance at 20 roentgens/min. In these cases the dose was 675 roentgens/air (925 roentgens with backscatter). This gave a tumor dose of 110 per cent SUD for the first series and 70 per cent SUD for the third.

The age of the patients treated ranged from 17 months to 72 years with the peak incidence of the tumors (71%) being between 25 and 45 years. The authors do not present the histological classification of their cases, but refer to the general agreement in the literature that malignant teratoma tends to occur in younger people, reaching a peak incidence at the age of 23 in the series of Friedman and Moore and carrying a poor prognosis, whereas seminoma had a peak incidence at the age of 30 in the same series and a better prognosis.

The authors studied the 5, 10, and 15 year survival rates in their series from a number of clinical aspects. They found that the patients presenting themselves for treatment in the fourth decade had the highest survival rate for all periods, although the frequency of metastases at the time treatment was initiated was as great as in some other age groups. The results were poorest in the very young.

Cryptorchidism (8%) other scrotal abnormalities (14%) such as hydrocele varicocele or epididymitis and gynecomastia (7 cases) did not appear to influence the prognosis unfavorably. Instead patients with these complications were apt to have their attention called to the tumor at an earlier stage and hence to receive more prompt treatment. About 70 per cent of this group of patients attained 5 year survival. In the same way a history of recent trauma (30%) was not unfavorable for it too tended to bring the patients for examination more promptly at a time when fewer of them showed obvious metastases. Sixty-one per cent of these survived 5 years.

On the other hand pain was an unfavorable symptom for those patients complaining of it showed a slightly higher incidence of metastases at the start of treatment and a much poorer survival rate (48% at 5 years and 28% at 10 years) than those with a painless swelling of the testis (62% survival at 5 years and 51% at 10 years).

As the duration of the acute progressive symptoms lengthened before treatment was sought, there was a steady increase in the per cent of metastases found at the time of first examination and decrease in the ultimate survival rate. Patients who received treatment within 3 months of the onset of symptoms had a 5 year survival rate of 71 per cent, compared to 42 per cent for those who had waited a year.

Forty three per cent of the patients had clinically evident metastases—para-aortic, supradiaaphragmatic inguinal pulmonary or generalized—when they first reported for treatment. Yet the statistical analysis showed that even these patients had some chance for long time survival for 31 per cent were living 2 years later 29 per cent at the 5 year period 19 per cent at 10 years and 7 per cent at 15 years. The survival figures for the group without obvious initial metastases were of course much better 91 per cent at 5 years 78 per cent at 5 years 66 per cent at 10 years and 50 per cent at 15 years. If all the patients are taken together 55 per cent lived 5 years 43 per cent 10 years and 33 per cent 15 years. The 2 year survival rate was found to be a good prognostic index for 5 year survival.

These figures agree well with those reported in the literature for patients with a malignant testicular neoplasm treated by combined orchectomy and extensive irradiation the 5 year survival rate from various sources averaging about 50 per cent, with a few of 25 per cent for malignant teratomas (Schuts and Leddy 1946) and a high of 67 per cent for seminoma (Nash and Leddy 1943). They are in sharp contrast to the over-all survival rates recorded following orchectomy only the highest 5 year rate being the 24 per cent reported by Higgins and Blichert in 1939.

LILLIAN DONALDSON M.D.

**Röntgen Therapy of Carcinoma of the Female Urethra and Vulva.** FRANK BUSCHKE and SIMEON T. CANTRELL. *Radiology* 1948, 51: 135

On reviewing the literature the authors found that external roentgen therapy was not used in a sys-

tematic way for the treatment of the primary lesion of either carcinoma of the vulva or urethra. Indeed by some it was branded as an inadequate weapon in these neoplasms if used within limits that avoided deleterious by-effects. The authors believe this to be a misconception based on an insufficient appreciation of the importance of the quality of the radiations used. They agree that low voltage irradiation will not be tolerated by the vulvar mucosa in doses necessary for sterilization even if the entire tumor can be irradiated homogeneously at such voltage but their own experience with a small group of cases followed up over a period of years indicates that with radiation in the 200 kv range a tumor-sterilizing dose can be delivered which is still tolerated by the sensitive vulvar mucosa.

The authors are of the opinion that comparatively small carcinomas originating in the labia, clitoris, or posterior commissure are better treated by radical excision radiation therapy being reserved for the more advanced stages of these lesions in which surgery cannot be expected to remove the entire lesion because of diffuse extension into the neighboring subcutaneous structures. They find the curability by radiation therapy even of advanced lesions in these locations reasonably good because of the comparatively low degree of differentiation of the epidermoid carcinomas usually encountered there. They also consider radiation therapy as the procedure of choice in the treatment of even small lesions in the penurethral portion of the vulva, the surgical removal of which would necessitate the destruction of the urethra often with poor functional results.

Carcinomas originating in the urethra itself present a different histologic picture since they frequently originate from glandular structures and undergo metaplasia into adenocarcinoma often exhibiting less radiosensitivity than vulvar carcinomas. However neoplasms in this region give symptoms at an early stage when tumor volume is still small and can therefore be included in a small field of irradiation. Hence the reaction can be kept within reasonable limits of intensity and late tissue changes are minimized while satisfactory function is maintained.

Therefore the authors selected early carcinomas of the urethra and advanced carcinomas of the vulva for radiation therapy. The vulvar group was comprised of 8 cases too advanced for radical surgery. The patients ranged in age at the time of treatment from 39 to 82 years. Of them 5 were well 7 5 3 2 5, and 1 15 years respectively. Three who already had obvious regional metastases at the time treatment was undertaken were dead in a little over a year. The doses in the controlled cases varied between 4 000 and 4 500 roentgens/skin given in from 20 to 26 days through fields measuring from 20 to 35 sq cm. Mucosal reaction developed between the sixteenth and twenty fifth days following the beginning of treatment, and was not completely healed until the forty-second to forty fifth day. Permanent mucosal changes were minimal.

Four cases of true carcinoma of the female urethra including 1 undifferentiated epidermoid carcinoma and 3 adenocarcinomas, are presented. Two other cases with treatment for carcinoma but on later histologic review classified as urethral caruncles are also recorded for the late condition of the mucous membrane after heavy irradiation. These carcinomas received 31 total roentgen therapy directed against the urethral opening through one field 3.5 cm. in diameter with the beam coinciding with the axis of the urethra.

All of the patients in this series were treated with 200 kv. radiation with from 1 to 2 mm. of copper filtration. The first patient aged 61 received skin dose of 565 roentgens in 3 days and developed a massive primary reaction lasting from the twentieth to the sixty-fourth day which at times necessitated the use of an indwelling catheter and was productive of a small area of late necrosis 1 year after treatment. However the patient is well with good function 5 years after irradiation but with a mild grade of urethral stricture and moderate mucosal atrophy and telangiectasis. The changes are sufficient to necessitate constant lubrication and scrupulous cleanliness of the parts to avoid intercurrent infection and the authors consider the result to have been overtreated. The 3 patients with urethral adenocarcinoma aged from 57 to 65 re-

ceived only 5,200, 4,600 and 5,000 roentgens/skin in 22, 32 and 29 days respectively. The first of these developed a mild mucosal reaction between the twenty-eighth and fifty-first days with a small area of late necrosis at 6 months, and has been well now for 4 years with good function and very slight mucosal atrophy. The 2 other patients received, respectively 4,600 roentgens in 32 days and 5,000 roentgens in 29 days and developed mild mucosal reactions from about the thirty-sixth to forty-fourth days followed by excellent healing. One has been well for 2 years, the other a year followed up for only 1 year shows the primary site to be healed but has required excision of a metastatic nodule in the adjacent labium and skin.

In reviewing the immediate and late results in this small series of cases of urethral carcinoma the authors believe that a total dose of around 5,000 roentgens/skin in about 25 days is tolerated by the mucous membrane for the small fields necessary in this type of lesion and is apparently sufficient for permanent sterilization. They regard the limit of tolerance not over 5,200 roentgens/skin and warn that the reaction of the tumor and surrounding mucosa in this location appears late after the end of adequate treatment and cannot therefore be used as a guide in the conduct of therapy for these rare lesions.

LILLIAN DONALDSON, M.D.

## MISCELLANEOUS

### CLINICAL ENTITIES—GENERAL PHYSIOLOGICAL CONDITIONS

**Trophic Nerves and Dupuytren's Contracture** (Trophische Nerven und Dupuytren'sche Fingerkontraktur) PAUL REICHEL. *Chirurg* 1946 17-18 97

The author presents the question as to whether or not there are truly trophic nerves.

Three possibilities might explain the trophic changes which occur following the interruption of a nerve. The changes may be produced by a vasomotor effect, by traumas to which the denervated part cannot react normally because of the anesthesia or absence of normally protective reflexes, or by the lack of certain, at present unknown influences exerted by special trophic nerve fibers.

The author is an adherent of the third theory and justifies his opinion by pointing out the appearance of corneal ulcers following gasserian ganglion resection, which he does not believe can be caused simply by trauma or a vasomotor effect.

Reichel has observed 5 cases of Dupuytren's contracture following injuries to the ulnar nerve. In all of these the nerve injury was unilateral, but the connective tissue changes were bilateral. This he feels is easily explained on a nervous basis. Furthermore, he suggests that an accurate anamnesis in cases of Dupuytren's contracture will often reveal a history of trauma, sometimes remote in time and location to the ulnar nerve. He concludes that this entity is a trophic neurosis. WILLIAM C. BECK, M.D.

**A Case of Juvenile Dupuytren's Disease** (Su un caso di morbo di Dupuytren giovanile) VITTORIO FINA. *MON. Ann. med. nov. Roma*, 1947 51 97

The author describes a case of Dupuytren's disease in an 18 year old boy in whom this condition had been present for some years. He first noted difficulty with the small finger of his right hand and this gradually increased. The next three fingers were then also gradually affected in a similar manner. When examined he showed marked flexion of all four fingers and only the index finger could be extended to any degree. The usual cordlike structures were palpable in the palm.

Under local anesthesia an excision of the palmar aponeurosis was performed with good results. The author cautions against the addition of adrenalin because of the reported cases of gangrene following its use in association with local anesthesia of the extremities. Early diagnosis is stressed as well as the necessity of resorting to surgery before ankylosis of the phalangeal joints occurs.

The literature on the subject is reviewed. Felix Plater first mentioned this condition in 1821 and Cooper recognized it in 1821 but it was first accurately described by Dupuytren in 1832.

LEONARD J. FROVOT, M.D.

**Surgical Repair of the Hand. New Material for Plastics of the Hand. Preliminary Communication** (Cirugía reparadora de la mano. Nuevo material para plásticos de la mano) CARLOS A. DERRIEN. *Dis. med. B. Air* 1948 20 927

The material used by the author in 2 cases consisted of strips of bovine fascia which are very pliable and extremely well tolerated by the organism. In fact, the favorable results obtained with this material tend to make him prefer it to autografts and to base great hopes on its possibilities. The advantage of obtaining a graft without having to increase the risks and the stages of the operation and the ease with which large amounts of this fascia can be obtained have led to the creation of a simpler technique for extensive tendinous plastic operations.

Four years before admission a woman of 40 suffered a wound of the digitopalmar fold of the annular and index fingers of the left hand which left these fingers stiff and without flexion because the corresponding tendons were severed. Under local anesthesia in the middle third of the forearm and block of the nerves at the wrist an incision in the form of an S was made and it was found possible to reunite the two ends of the tendon of the index finger according to Bunnell's technique. The suture site was enveloped in a sheath of bovine fascia to avoid adhesions. The distal tendon of the ring finger had disappeared therefore an external and lateral incision was made and a strip of fascia was sutured to the third phalanx. Two strips of the same material were placed around the other two phalanges to serve as pulleys and the proximal end of the first strip was then sutured to the remaining tendon. The skin was closed with linen sutures and a dorsal plaster of Paris gutter was used for immobilization with the fingers in semiflexion. Unfortunately the patient developed ischemia of the third phalanx and later its distal portion was eliminated but a good stump was left. Recuperation was estimated at 60 per cent of normal.

A man of 27 suffered a wound of the lower third of the back of the right forearm which resulted in the loss of extension of the three last fingers. Under local anesthesia at the middle third of the arm an arclike incision was made 20 cm. in length and scar tissue was found to envelop the severed ends of the tendons for about 8 cm. The scar tissue was resected and the tendon stumps were freed until healthy tissue was reached. Two parallel strips of bovine fascia 8 cm. long were used one for the tendons of the middle and ring fingers and the other for the little finger. To avoid adhesions with the superficial tissues, the strips were enveloped in a vein taken from the cutaneous flap. The extremity was kept at rest in a plaster of Paris gutter which was removed after 15 days. Recuperation of function was 100 per cent. RICHARD KEMEL, M.D.



**Repair of Cicatricial and Dupuytren's Contractures of the Hand.** HARRIS STAY *Plast. Reconstr. Surg.* 943, 3-459.

The common causes of cicatricial contractures of the hand are shrinkage of the skin and fascial structures from prolonged and rigid immobilization of the hand in faulty position after injuries, infections, and burns. The vast majority of these contractures could be avoided if the hand were immobilized in a position of function. When the wrist is held in flexion, that is, in wrist drop and allowed to remain in this position, the extensor tendons are maximally stretched; hence, they cannot be relaxed further if an attempt is made to close the hand to make fist. This prevents full function of the flexor tendons. The fingers are drawn in hyperextension in the metacarpophalangeal joints, the thumb is drawn back to the side of the hand and the collateral ligaments of the metacarpophalangeal joints are relaxed and shortened. There is a rapid shrinkage of the collateral ligaments, which prevents normal gliding of the phalangeal joint surface over the head of the metacarpal bone. The posterior part of the joint capsule is contracted. The entire lumbricale system is upset. This is the well known picture of the claw hand.

This contracture can be prevented by immobilizing the hand in the position of function, namely, extension or cocked up position of the wrist, midflexion of the metacarpophalangeal and interphalangeal joints, and abduction and opposition of the thumb. If contractures have developed, those of the thumb should be overcome first by conservative methods in the form of elastic splinting with the incorporation of elastic traction, in association with occupational and physical therapy, or by operative reconstruction. Burn contractures present some of the most difficult problems of reconstructive surgery. The difficulty is primarily because of the depth of the scar, while in other parts of the body, severe burn does not cause any functional damage since the epithelium regenerates from the remaining layer of the cutis, on the hand particularly at the dorsum, second degree burns quite frequently are followed by severe contractures from keloidlike scars. The contractures of the deeper structures, namely, the fascia, ligaments and tendons are most disastrous. Most of these can be avoided if the hand is properly immobilized during the healing stage and skin grafting is employed early. This is true especially in third degree burns.

The principle in correcting these contractures consists of excision of the entire cicatricial surface tissue followed by repair of the contracted fascial structures, and closure of the defect with a graft or flap. A free graft, however, will not take on naked tendons, bones or joints; therefore every effort should be made not to expose these structures during the excision of the cicatrix.

The operation is carried out in a bloodless field, the use of a pneumatic tourniquet. The entire incision is outlined with an incision and the depth of the incision depends upon the depth of the scar tissue. In a second degree burn the excision of the cicatricial

skin is carried at the level of the subcutaneous veins. Care should be taken not to injure them. In third degree burns excision of the scar tissue is done at the level of the deep structures. However, care should be taken not to expose the tendons if the use of a free skin graft is considered. In the majority of cases, exposure of the tendons can be avoided by removing the scar tissue over the tendons in layers and stretching of the tendon is gradually done by cross-cutting the covering tissue in numerous places until full or almost full relaxation of the tendons can be reached. The forearm and hand is then immobilized in the position of function. Oftentimes, a wire is passed through the terminal phalanx and fastened to the end of the splint. The splint is bent until the fingers are in 45 degree flexion in all the joints. The defect is then covered with a full thickness graft or with a thick split graft. If the tendons are exposed, the use of a pedicled flap is the only choice. Sutures are removed after 8 days and the splint remains in place for another 6 days. Warm saline hand baths are administered daily with active and passive motion exercises while the hand is in the water. The splint is discarded entirely 3 weeks after the operation.

Dupuytren's contracture of the palmar aponeurosis must be classed among diseases of unknown origin. The disease progresses gradually to involve not only the palmar part of the aponeurosis but the fourth and fifth fingers, less often the other fingers, but very rarely the thumb. It is impossible to restore mobility of the fingers if the latter are arthritic and ankylosed. Insufficient removal of the diseased structures invites recurrence. The peculiar process is not confined to the palmar fascia alone but often the skin over the diseased fascia is involved so that recurrence of the contracture in the skin occurs, even after removal of the underlying fascia. Because of the involvement of the skin and the fascia both should be removed when involved, and only after complete removal of the fascia and fascial extensions can recovery be expected with return of good function.

The excision of the involved fascia and the involved skin must be radical. For example, it must include the fascial extension over the thenar region, the extension to the second, third, fourth, and fifth fingers. It must include the fascial extension, which connects the fascia with the underlying tendons and tendon sheaths and also the diseased skin island. Great care should be carried out in the dissection to avoid injury to the digital nerves and vessels. The tendon sheaths should not be opened.

The forearm, hand and fingers are immobilized in the position of function and a pressure dressing is applied. If the excision results in the exposure of the tendons, closure of the defect with an abdominal flap is advisable.

JAMES E. KARRARY, M.D.

**Hodgkin Disease 1832-1947.** HERMAN A. HODGKIN and MARY B. DEATHMAN. *Cancer Res.* 1948, 8: 49.

Malpighi first described this disease in 1661. Hodgkin evaluated this disease as a clinical entity in

1832 in 1872 Langhans noted the presence of giant cells in lesions from this disease. In 1902 Dorothy Reed made her classic contribution to the histopathology of the disease. Scores of names have been applied in the past but the official name now is simply Hodgkin's disease. The recorded incidence in the United States varies from 0.5 to 2.5 per 100,000 living population. Increased incidence has been reported in the last two decades possibly because of the increased use of biopsy as a diagnostic procedure. The disease has a world wide incidence. It can occur at any age but is most frequent in young adults. Males are affected twice as often as females and in childhood the ratio increases to more than 4 to 1. It has been said that the disease occurs more often in more than one member of a family than can be accounted for by chance alone.

Hodgkin's disease is considered to be a disorder of the entire reticuloendothelial system but it affects the lymphatic system primarily. The rate of spread from node to node is variable and progressive with exacerbations and remissions. Some say the deeper nodes are really the first to be involved. The nodes are involved in chains and may be discrete or matted. The younger growths show a uniform gray bulging surface on section. The older ones are harder and show opaque intersecting yellow lines of fibrous tissue. There is little necrosis or suppuration. Splenomegaly is frequent and hepatomegaly less so. Gastrointestinal lesions are rare. Other abdominal organs are occasionally affected but it is chiefly the abdominal nodes which are diseased. The mediastinal nodes are often involved and there may be spread to the heart and lungs. Pleural effusions are frequent. Bone lesions are a very frequent late manifestation. Direct invasion of the nervous system is rare but neurological symptoms are fairly common as the result of lesions of the meninges and surrounding bone. Varied and perplexing skin lesions often occur. The primary site is very difficult to evaluate because the disease is seldom diagnosed until it is moderately far advanced. The earliest microscopic change is said to be a proliferation of reticulum cells in lymph nodes. The spaces in the nodes are filled with these cells and with lymphocytes. Then there is a development of many eosinophiles multinucleated cells and large mononuclear cells followed by a conversion or degeneration of these cells into fibrous tissue. There is a reduction of lymphoid tissue of the normal type in involved organs and in uninvolved organs. There are various classifications of different phases of the disease such as paraneoplasma granuloma and Hodgkin's sarcoma. Some believe the first two are chiefly inflammatory in nature while the latter is frankly malignant but different nodes in the same patient at one time may show each of the above "stages."

Many authors relate the origin of Hodgkin's disease to recent infections about the head or respiratory tract but this may be an effect and not a cause. Tuberculosis is fairly often concurrent with this dis-

ease. Painless progressive enlargement of lymph nodes is the chief presenting complaint. Other symptoms are weight loss anorexia fever pruritus cough and dyspnea. Remissions and exacerbations in the early disease are quite unpredictable. The Pel-Ebstein type of fever may occur. Pain is a common later symptom and is often due to bone lesions. The final diagnosis of the disease rests on biopsy. The prognosis is that of inevitable death but this may occur a few weeks after diagnosis or not for many years. Females with the disease are said to live longer than males. The duration of illness is very hard to establish since the actual onset can usually not be determined even within several months. Death is due to generalized visceral invasion, secondary infection, or to destruction of the bone marrow. Terminal anemia is common. Changes in the white blood count are not constant or diagnostic. Marked eosinophilia is rare. Aspiration of the sternal marrow is not a positive diagnostic procedure. Most patients have an elevated sedimentation rate during active stages of the disease. No complement fixation or other serologic test has been devised. Without invasion of the kidney or pressure on the excretory urinary tract urine changes are only those to be expected with any chronic, febrile disease. The elevation of the basal metabolic rate is proportional to the extent and the activity of the disease. Patients with advanced disease fail to react to the tuberculin skin test.

Röntgen radiation is the treatment of choice for localized disease. Some believe this does not influence the duration of life. Radiation must be used with care in the presence of tuberculosis and a depressed bone marrow. Superficial nodes are much more successfully treated than deep ones. Radium is not very useful with this disease. Other radioactive substances have been disappointing. In early cases, radical local excision plus radiation often gives better results than would be expected. Surgery may be necessary to relieve dangerous neurological symptoms due to pressure such as paraplegia. With this exception, some authors believe that surgery is useless and often dangerous. Vaccine and serum therapy have been disappointing. Chemotherapy with the exception of the use of the nitrogen mustards (which are somewhat effective) has also unfortunately been of little or no avail.

There is much argument as to whether Hodgkin's disease is a neoplasm an inflammation a disease midway between these first two or a metabolic disturbance. There is much evidence for either of the first two theories. The fatal termination suggests a neoplasm but the very variable clinical course with its remarkable remissions and exacerbations suggests an inflammation. The histopathologic picture can be argued either way. Perhaps the truth is nearest the view that combines these two opposed theories. Unfortunately this disease does not occur and cannot be produced in laboratory animals. Transmission experiments to animals have also failed in all but a few dubious cases. Many different

bacteria have been isolated from Hodgkin's nodes but this means little since the same bacteria can also usually be obtained from control nodes. Much of the early work in this field is of almost no value because of very inadequate aseptic procedures. Diphtheroids, brucella organisms, and tubercle bacilli have been especially worked with, but many authorities now say that none of these is directly concerned in the etiology of Hodgkin's disease. Gordon discovered an interesting encephalitic reaction in rabbits injected with material from Hodgkin's nodes. There was hope for a time that this might be useful as a diagnostic procedure but this failed when it was found that the same reaction could be elicited with many other types of material than Hodgkin's nodes and was apparently correlated with the concentration of eosinophiles in the material injected. Recently interesting viruslike (?) inclusions have been demonstrated in tissue cultures of normal human lymph nodes grown in a fluid to which has been added a cellfree extract of Hodgkin's nodes.

JAMES WEAVER, M.D.

**Hyperthermia as Association with Shock.** JAMES L. HANSEN *Acta chir scand.* 948 p6 530.

The author presents clinical evidence to show the close association between shock and hyperthermia postoperatively in some cases. He suggests that the syndrome can be delimited on a purely clinical basis and should therefore be considered a specific post operative condition.

This investigation extended over a period of 4 months, during which rectal temperatures were measured every hour for the first 24 hours after all operations of any size. Twelve of 20 patients with typical shock revealed no characteristic fluctuations of the temperature but in 7 a rectal temperature of between 39.1 and 40.5° C. (102 and 104° F) was recorded in from 3 to 6 hours after operation. The fever reached its maximum at the time the shock was most pronounced.

Blood samples were taken one to three times during the temperature rise, but the blood cultures were negative and the subsequent course revealed no evidence of infection neither did the postmortem examination in 2 patients who died. After successful treatment of the shock the temperature fell at the same rate at which it rose, from 25 to 0.5 degree per hour.

Typical postoperative shock is often found to be associated with a sudden rise in temperature. It is stressed that the abrupt temperature rise occurs without chills and that the perspiration ceases during the temperature fall. The rise in temperature at tending shock is due to reduced elimination of heat secondary to arteriolar contraction, mainly in the extremities, and the condition occurs when the organism strives to conduct the reduced circulating amounts of blood to the vital centers in the medulla oblongata. The temperature promptly falls after treatment of the shock by blood plasma, and fluids. Blood cultures, the subsequent clinical course, and

autopsies reveal no evidence of infection or other pathology as the cause of the hyperthermia.

JOHN H. MCKARDY, M.D.

**Pterygium Colli and Allied Conditions.** H. O. FORD. *Canad. M. Ass. J.* 948 59 151.

The author presents a case of pterygium colli in a 19 year old patient, with a description of a new surgical procedure for the correction of this deformity.

An incision about 3 inches long is made in the midline posteriorly and the skin is undercut. A second incision about 5 inches long is made transversely at the top of the first incision forming a "T". Each flap of the skin is then raised and pulled upward and inward until the skin folds are obliterated as in operations for the removal of wrinkles. The excess skin is excised to leave a triangular defect. The skin edges are sewn together in the form of a "T". The scar is posterior and well hidden by the hair or collar. Both folds are corrected through one operative field and it is possible to obtain symmetry very easily.

The author then reviewed the literature concerning various cases of pterygium colli, and he states that the condition is rare and widely distributed geographically. It does not appear to be hereditary but has been reported in 2 sisters.

In its simplest form it consists of a bilateral fold of skin arising from the mastoid region but occasionally from in front of the ear and extending to the shoulder. Usually it is thin but it may be thick and can be picked up and stretched to the side of the neck. It consists of skin and subcutaneous tissue although it has been suggested that there may be some abnormality of the platysma myoides. The deep fascia and muscles are not affected. It is possible that there may be some deficiency and loss of tissue but there is no histologic evidence for this. The hairline is low posteriorly giving the appearance of a short wide neck. The cervical vertebrae are normal and there is no impairment in movement. In most instances there is no mental retardation but in some cases the condition suggests mongolianism.

Rarely however does it occur as simply as this, but is associated with a wide variety of malformations. Because of this association with these anomalies it is suggested that it is the result of faulty development of the neck and is thus related to Klinefelter's Klippel Feil syndrome and Sprengel's deformity and that the signs of these may overlap. A special subvariety has been described which exhibits the triad of infantilism, webbing of the neck, and cubitus valgus, and occurs in women. However this type has also been reported in a man.

Endocrine deficiency when present, may be regarded as secondary to the underlying congenital defect, and not as the primary cause of the condition. Endocrine therapy has caused some improvement in the genital symptoms.

In most reports there is no mention of treatment of this defect. One author suggests a bloodless orthopedic procedure. The only surgical techniques described were modifications of the "Z" type plastic

operations. General reference was made to other plastic methods without elaboration.

JOHN E. KARABIN, M.D.

**Morbidity and Mortality in Talc Granulomas: Report of a Fatal Case.** ALVIN J. SWINGLE, *Ann. Surg.* 1948 128 144.

After a survey of the literature and on the basis of his own observations the author re-emphasizes the incidence of morbidity and postoperative complications in which talc powder has been incriminated as the etiological agent. He records the course of a patient who was operated on 14 times for adhesions and intestinal obstruction between her first and final admissions which terminated in the death of the patient, and gives the autopsy findings.

The clinical and experimental evidence incriminating talc as the etiological agent in the formation of intraperitoneal granulomas and adhesions is reviewed. In addition talc granulomas have been reported in the skin, vagina, rectum, eye, gall bladder, healing surgical wounds, scars, and brain. In the Veterans Hospital, Wood, Wisconsin, Ross has found a large number of granulomatous lesions of the foreign body type among routine surgical specimens definitely identified as talc granulomas.

The commercial talc used on surgical gloves has been found to contain talc (82.7 per cent), calcium carbonate (8.7 per cent) and magnesium carbonate (7.6 per cent). 55 per cent of the particles were less than 5 microns in diameter. The portals of entry have been found to be perforations of gloves which occur in 22.6 per cent of all the gloves used, and rubber drains powdered with talc for autoclaving. Regardless of how thoroughly they are washed, subsequent examination under the polarized microscope will reveal many birefringent crystals still clinging to the rubber.

Since talc powder has been so conclusively demonstrated to be a dangerous agent in surgery, its use should be discontinued. Of the substitutes offered to date, the modified corn starch preparation recommended by Lee and Lehman seems best to fulfill all the requirements of a dusting powder suitable for use on surgical gloves and drains.

JOHN H. MOHARDT, M.D.

**Mineral Balance during Brief Starvation.** The Effect on Serum Electrolytes and Mineral Balance of Maintaining the Intake of Certain Mineral Constituents. LEROY E. DUNCAN, JR., RICHARD J. MEYER, and JOHN EAGER HOWARD. *J. Clin. Invest.*, 1948 27 359.

Two obese male patients were subjected to two periods each of 4 days of starvation. During one fast, each of the patients received only water. In the other, a salt mixture containing approximately the amounts of sodium, chloride, potassium, and phosphorus of a 1,200 calorie diet was given in addition to the water. Between the two fasting periods both patients were fed a diet containing 1,200 calories for 6 days.



Fig. 1 (Foucar). Pterygium coli or webbed neck, lateral view.

Fig. 2. Posterior view showing folds of skin and low hair line, which give the appearance of shortness to the neck.

Fig. 3. Posterior view showing laxness of the skin.

Fig. 4. Lateral view after operation showing complete obliteration of the fold. Note also the inconspicuous scar posteriorly.

Administration of the salt mixture resulted in no lessening of the nitrogen lost by fasting and effected no alteration in the amount of weight lost. In one patient there appeared to be a considerable saving of potassium from the salt mixture in the other patient none.

On the first day of the fasts, large savings of sodium and chloride were manifest from the salt mixtures, but thereafter excretion of these elements was rapid, and the total amounts of sodium and chloride lost over the 4 days were the same in the fasting periods with and without the salt mixtures.

The sodium, chloride, and potassium of the mixtures were almost completely absorbed, as judged from the quantities of these elements in the stools and by the increased amounts appearing in the urine. There was no appreciable rise in phosphaturia when the salt mixture was given as compared with the fasting alone. In one of the patients there was heightened calciuria and hypercalcemia as a result of the salt mixture.

The concentrations in the serum of sodium, chloride, and potassium were unaltered by the salt administration. Stools were more frequent during fasting when the salt mixture was given, but only minimal amounts of the administered salts were recovered in the stools. WALTER H. NADLER, M.D.

Penicillin, Streptomycin, Dicumarol and Blood Coagulation: Thromboplastic Properties of Penicillin. DAVID L. MACINTYRE. *Soudh. M. J.* 1943, 4:1720.

Animal experiments and records of clinical patients show that penicillin shortens the coagulation time and the prothrombin time of whole blood. Some of the four crystalline-active principles of penicillin are more effective in this regard than others. For this reason, amorphous penicillin is more effective in shortening coagulation time than are the newer colorless crystalline preparations. Suitable doses of dicumarol can be used to antagonize the excessive thromboplastic effects arising from intensive penicillin therapy. In experiments on animals the reverse is shown, in that the prolongation of prothrombin time and whole blood coagulation which is produced by dicumarol can be corrected by penicillin. This mutual correction of penicillin and dicumarol enhances their use.

JAMES WEAVER, M.D.

An Italian Precursor to the Study of Penicillin (Un italiano precursore degli studi sulla penicillina). GIUSEPPE PIZZU. *Ann. med. nat. Roma*, 946, 51: 32.

The author states that on page 91 of the first number of the *Annali d'Igiene Sperimentale* for the year 1895 appears an article entitled "On the Extracts of Certain Molds—Researches by Doctor Vincenzo Tiberio." He then gives important quotations from the original article, which bring out the work done by Vincenzo Tiberio on molds. This work was done before Tiberio entered the naval medical service while he was an assistant in the Pathologic Institute and afterward in the Institute of Hygiene of the University of Naples.

The original article is divided into three parts: (1) preparation of the cultures, (2) preparation of aqueous extract with bactericidal power, and (3) the chemotactic power and action of molds in the experimental infections with the typhoid bacillus and Vibrio of cholera.

The conclusions arrived at by Tiberio and quoted by Pizzu are as follows:

"In the cellular substance of molds are contained water-soluble principles which possess a bactericidal action. I do not pretend to state that this action extends to all bacteria. The liquid obtained (from penicillium and aspergillus) is endowed with notable chemotactic powers. This liquid has a preventive and therapeutic action."

Thus, Pizzu states that although the work of Tiberio remained within the limits of the laboratory, the concepts arrived at by him were exact. A brief review is made of different products derived from organisms and used as antibiotics and therefore leading up to streptomycin.

A brief life history of Vincenzo Tiberio follows, showing that he was born on March 1, 1869, and died on January 7, 1915. At the time of his death he was Director of the Cabinet of Hygiene and Bacteriology at the Marine Hospital in Naples.

LEONARD J. FROSTETT, M.D.

The Toxicity of Sodium Alginate in Cats. MAYNARD B. CROSWORTH. *Ann. Surg.* 1943, 117: 73.

An absorbable, hemostatic, and readily manufactured surgical gauze which can be sterilized by autoclaving can be prepared from alginic acid, the product of certain seaweeds. Because of the usefulness of absorbable surgical gauzes, the discovery of a material which, on manufacturing grounds, is as suitable as alginic acid, is very important. The toxicity of commercial sodium alginate was studied by the intraperitoneal or intravenous injection in cats. Solutions of sodium alginate resulted in the production of large antemortem intracardiac clots. The toxicity of alginate gauze was also studied by this author.

As the result of this study of the action of alginic gauzes in the animal body, the material cannot be recommended for surgical use as an absorbable gauze. It would seem that the ability of alginic acid to form gels with calcium, which may or may not be the mechanism underlying its hemostatic action, is sufficient to cause serious localized circulatory embarrassment.

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# SURGERY

## GYNECOLOGY AND OBSTETRICS

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### POSTTRAUMATIC VASOMOTOR DISORDERS

With Particular Reference to Late Manifestations and Treatment

HARRIS B. SHUMACKER, JR., M.D., Indianapolis, Indiana, and

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**A**LTHOUGH generally injury to an extremity is followed by signs and symptoms which are readily explained upon the basis of the trauma sustained and the resultant dysfunction in certain instances there are superimposed other changes which can be accounted for only on the assumption that some reflex disorder has been initiated by the local tissue damage. Such a reflex state has been the subject of gradually increasing study and interest since 1900 when Sudeck first presented the entity of acute atrophy of bone following certain inflammatory processes. The numerous terms<sup>1</sup> which have been utilized to describe this clinical condition bear witness not only to the widespread disturbances which may occur but also to the lack of agreement as to what constitutes the primary characteristic alteration. Since the most constant finding is some type of vasomotor disturbance it is our feeling that the broad term posttraumatic vasomotor disorder is the most appropriate name for this clinical entity.

From the Vascular Center, Mayo General Hospital, Calesburg, Illinois; the Department of Surgery, the Indiana University Medical Center, Indianapolis, Indiana; the Department of Medicine, the University of Illinois College of Medicine; and the Department of Medicine, Michael Reese Hospital, Chicago, Illinois.

Among the names which have been given to the syndrome are the following: Sudeck's atrophy, acute atrophy of bone, post-traumatic osteoporosis, posttraumatic painful osteoporosis, traumatic atrophy, peripheral trophoneurosis, reflex nervous dystrophy, reflex sympathetic dystrophy, posttraumatic dystrophy, minor causalgia, traumatic angiospasm, chronic traumatic edema, and posttraumatic edema.

Excluded from such a category are a number of related conditions. Among these are major causalgia and phantom limb pain syndromes with such characteristic features that they are best considered as separate entities. Marked sympathetic overactivity may be present in certain cases of occlusion or division of peripheral arteries associated with trauma. However, in those conditions in which the occluded vessel is of real importance in the nutrition of the extremity, part of the resultant difficulty arises from the direct decrease in local blood flow and hence this type of vasospastic alteration is likewise better separated from the post-traumatic vasomotor disorders. There is also good reason to exclude from this group the vasospastic state which follows cold thermal injuries—frostbite, trench foot and immersion foot—and that which is associated with deep thrombophlebitis. Those vasomotor disturbances which are apparently the sole result of disuse likewise do not belong to the category of posttraumatic vasomotor disorders. Although all of the conditions mentioned have a number of features in common, each possesses certain peculiar characteristics which make it advisable to deal with it as a distinct syndrome.

It is generally accepted that the primary mechanism responsible for posttraumatic vasomotor disorders is some type of reflex disturbance initiated by the local injury and involving in the reflex arc the components of the sympathetic nervous system. Although nu-

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C. FRED GOEDENOW, M.D.

plaints were explicable solely on the basis of the local tissue injury.

The commonest story elicited was that of the development of severe pain in the affected hand or foot shortly after injury associated with swelling, coldness, and cyanosis and often excessive sweating. Active use of the hand or foot was impossible because of pain on movement or on weight bearing. A few patients had no significant pain but instead noted evidence of excessive sympathetic activity such as coldness, cyanosis, and hyperhidrosis. In some edema out of proportion to the injury sustained was the most striking finding while others had increased vasomotor tonus without edema. Marked weakness of the involved limb was almost constantly present.

It is worthy of note that there was nothing in the history or clinical records of these patients to suggest that the early circulatory alterations were those of vasodilatation and increased blood flow as has been described by some investigators (11) and as we have observed in some of our civilian patients. Indeed the prominent initial findings were those of sympathetic overactivity.

#### EARLY TREATMENT

In the majority of the patients no active effort was made during the first few weeks after injury to treat anything but the local lesion. Wounds were properly debrided and foreign bodies were excised when deemed advisable. Fractures were immobilized in plaster. Very few patients were treated by casts in whom there was no fracture or other specific indication for such therapy. Warm compresses locally and sulfonamides by mouth or penicillin parenterally were used to combat infection.

When it became apparent that some profound vasomotor disturbance was superimposed upon the local injury, other methods of treatment were instituted. Those most commonly utilized were contrast warm and cold baths, Buerger's exercises, whirlpool baths, massage, and local heat. Little serious effort was made to establish early active motion and weight bearing. In only 2 patients were sympathetic blocks employed during the first

month of the difficulty. One of these underwent continued improvement after 2 blocks carried out during the second week following the injury. When examined several months later he demonstrated few sequelae. The other patient derived transient benefit from a single block performed on the day of injury and significant lasting improvement from several blocks done 5 months later.

#### LATE MANIFESTATIONS

An average of 5 3 months had elapsed between the initial injury and the time of admission of the patients to the Mayo General Hospital. In the interval the correct diagnosis had usually been established although some cases were still considered examples of deep venous thrombosis, thromboangitis obliterans, or other primary vascular disorder.

In Table I are listed the chief complaints elicited on admission and the physical findings noted upon examination. Pain, edema, coldness, and cyanosis were the commonest symptoms. Nearly one-fifth of the patients had sensitivity of the affected part to cold and in a few this disturbance was very severe. Other individuals complained of stiffness, numbness, or chronic ulceration. Pain was primarily experienced on weight bearing or other activity. Though commonly described as an aching sensation it was throbbing in character in some patients and burning in others. It prevented normal physical activity in most instances and its long duration had generally completely destroyed confidence in the ability to use the affected limb properly. Only 2 patients had moderate burning pain at rest which differed from true major causalgia in its inconstancy. Some individuals complained of massive swelling but most of them of only mild or moderate edema.

Upon admission 21 of the 111 patients with difficulties involving the lower extremities were confined to bed, 32 were ambulatory with the use of crutches, 16 with canes, and 42 walked without aid but with a definite limp. Those with involvement of the upper extremities tended to guard the affected limb and to avoid using it.

Examination revealed motor weakness of the affected limb in every instance amount



merous ingenious theories have been postulated no definite proof has been obtained to verify the correctness of any of them. They are discussed in other reports (1, 2, 7, 8, 10, 11) and to review them here would be profitless. Similarly no agreement has been reached as to the real cause of the osteoporosis which so commonly occurs (3).

The purpose of the present communication is to call attention to the clinical manifestations of posttraumatic vasomotor disorders as observed in a large series of cases and to discuss the merits and limitations of various therapeutic procedures. It is hoped that analysis of such a group will be useful in pointing out the heterogeneous disturbances found in this condition and the variety of measures which have an important place in its treatment.

#### CLINICAL MATERIAL

A study of 142 male patients with posttraumatic vasomotor disorders, involving 143 limbs, forms the basis for this report. All were soldiers admitted to the vascular center of the Mayo General Hospital after having first been treated in other army installations. The information concerning initial manifestations and early therapy is subject therefore to the criticism that it had been collected by other observers. However every effort was made to reconstruct the sequence of events and the results of early treatment through a careful perusal of the previous clinical records and through questioning the patients in detail with regard to the early phase of the disease. The data concerning late manifestations and the results of late treatment are based upon close personal observation during the period of hospitalization.

The subjects varied in age from 20 to 38 years, with an average of 27 years. Twenty-five had had a tendency to coldness of the hands or feet prior to the present difficulty and an equal number had noted in the past varying degrees of hyperhidrosis in the limbs. A history of previous injury to the affected limb was obtained in 5 individuals, and of frostbite or trench foot in 4. Eighty used tobacco. There was no definitely relevant family history in any of the patients, although such vascular difficulties as varicose veins, vascular

thrombosis or hemorrhage had occurred in the families of 12.

The disorder became manifest after soft tissue wounds in 58 patients, after sprains in 19 and after crushing or other external injuries in 11. In 14 it followed compound fractures of small bones, and in 7 simple fractures of small bones. In 24 it resulted from compound fractures of long bones, and in 5 from simple fractures of long bones. In 3 it was the consequence of infection while in 1 the surgical removal of a small cyst was the initiating cause. Besides the precipitating injury 19 of the patients had associated nerve paralysis and 4 had sustained laceration of a minor artery. One individual incurred a mild frostbite at the time of injury. In all cases but 1 the disorder began during army service.

In 111 patients a foot was affected and in 31 a hand. In the case of 1 soldier injuries to an upper and lower extremity were followed by vasomotor disturbances in the corresponding hand and foot. Not infrequently in patients who had no previous tendency to coldness of hands or feet, evidence of increased vasomotor tone now was present not only in the injured limb but to a lesser extent in the contralateral one or sometimes in all four. In such instances the symptoms were generally not marked in the uninjured extremity although 1 subject developed such severe cold sensitivity in both hands following injury to the left forearm as to require bilateral dorsal sympathectomy.

#### EARLY MANIFESTATIONS

The prominent initial symptoms and signs, obtained from a study of the early clinical records and from questioning the patients, were as follows: pain in 97 patients, swelling of the affected hand or foot in 95, cyanosis in 93, coldness in 72, hyperhidrosis in 52, numbness in 26 and pallor in 3. The symptoms were generally noticed within a period of from several days to a few weeks after injury. However in some individuals, whose initial trauma required immobilization of the limb in plaster signs and symptoms suggestive of a posttraumatic vasomotor disturbance became evident only when the cast was removed and the patient became ambulatory, the preceding com-

perature or sweating. Still others showed extreme local reduction in temperature or hyperhidrosis or both without significant edema or cyanosis.

In a number of cases reflex vasodilatation by means of body warming was carried out. In all instances but 2 the rate of rise in skin temperature was a parallel in the affected and normal extremity. In the 2 exceptions a lag was noted in the injured limb. In all instances however there was no difference in the ultimate height of rise of temperature in the injured extremity as contrasted with the normal one despite lower initial control skin temperature readings in the involved limb. In several cases the reactive hyperemia test was performed and uniformly the results in the affected limbs were normal except for a delay in the appearance of the flush in 1 instance.

Records of roentgenological examination of the hands or feet were available for study in 51 cases. In 42 there was evidence of generalized or spotty osteoporosis while in the 9 remaining no abnormalities were noted. The change was minimal in 6 cases, moderate in 28 and marked in 8.

Most of the patients had assumed the attitude and behavior of the chronic invalid. They were weary from prolonged disability and hospitalization and usually had a relatively hopeless viewpoint toward the possibility of eventual recovery. In some the concept seemed to be fixed that the condition from which they suffered was sufficiently disabling so that they could look forward to separation from the Service. In only 11 individuals however was a neuropsychiatric disorder diagnosed by psychiatric consultants. In the latter the general attitude and behavior were often no different from those of the group as a whole except that a few showed evidence of anxiety. They all demonstrated however certain local findings which were helpful in segregating them from the other patients. The most common observation of this sort was a forced effort in response to a request to perform a certain movement. This was associated with a gross tremor or with little or no movement of the part but with obvious contraction not only of the muscles

ordinarily utilized but of their antagonists as well. For example if a patient were attempting to extend his foot it was often apparent that both the extensors and the flexors were being brought into a state of tonic contracture so that no movement occurred except possibly a coarse tremor. This sign more than any other was helpful in establishing the presence of a definite psychomotor block.

#### LATE TREATMENT

The type of late treatment given and the results obtained will be considered under 4 categories namely active exercise and physical therapy, neuropsychiatric treatment, lumbar sympathetic block, and lumbar sympathectomy. The effect of treatment upon osteoporosis will be considered separately. It is realized that these divisions are somewhat arbitrary and overlap. For example whether or not a neuropsychiatric disorder was present and regardless of whether expert psychiatric therapy was required it was felt necessary to gain the confidence of the patient and to impress upon him both the necessity for his active co-operation and the favorable outlook that might be expected. Such instructions and suggestions on the part of the attending physician in reality constituted psychiatric treatment. Again active use of the involved extremity was part of the routine no matter what other type of therapy was carried out. It was learned early in the treatment of post-traumatic vasospastic states that little could be accomplished from psychiatric interviews, sympathetic blocks or sympathectomy if the patient was not urged repeatedly to take advantage of any resulting improvement in his condition by following up this gain with persistent use of the affected limb. It was only in this manner that the atrophy, weakness, stiffness, and improper stance or gait were ultimately corrected.

#### *Patients Treated Primarily by Active Exercise and Physical Therapy*

In 95 individuals active use of the involved extremity constituted the chief medical therapy. When the patients were first seen the importance of such a step was emphasized and explained to them in terms which they could



sary to impress upon all the patients the fact that they could accomplish much more by their exercising at frequent intervals throughout the day than by relying solely on the relatively short period of treatment given by the physical therapist. The same type of program was carried out in the case of the individuals suffering from involvement of the hands.

As improvement took place the patients as a rule underwent a change in attitude and became more optimistic concerning the outcome of their disability. Concomitantly with this altered state of mind they appeared to pursue the program more vigorously and to improve more rapidly. As a result the edema diminished (Fig. 1 a and b) and the gait became relatively normal. If discomfort was still present it was less severe, appearing only after the patient had walked for a distance of from 1 to 3 or more miles. At the same time there were noted an increase in muscle power and an alleviation of the vasomotor disturbance. Almost invariably the affected limbs which had been cold, wet and cyanotic on admission gradually became warmer, drier and better colored.

It is of interest to discuss in detail the results in one of the patients in this group.

This individual entered the hospital complaining of marked swelling, pain, coldness and hyperhidrosis of the right hand and the inability to use the fingers. He had sustained a fracture of the bones of the right forearm on a number of occasions previous to the onset of his symptoms. When the hand was first examined it showed marked edema and stiffness of all the fingers (Fig. 2 a). The patient was given an ordinary tight surgical glove to wear and was encouraged to use the fingers as much as possible. At the same time an intensive course of physical therapy was instituted and the patient was given a soft rubber ball which he kept squeezing most of the day. At the end of 2 weeks of this regimen the edema had completely disappeared and the patient was able to move the fingers of the right hand almost as well as those of the left (Fig. 2 b).

A satisfactory result followed active exercise and physical therapy in 50 of the 95 cases. Five other individuals were under observation too short a time to permit final evaluation of the treatment. In the 40 remaining patients little if any beneficial effects were noticed. In some respects many of the cases considered in the subsequent 3 sections also represent fail-

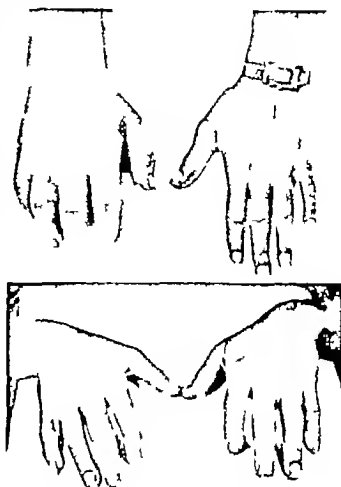


Fig. 2. Subsidence of edema with active exercise and physical therapy. a, above. Marked edema of right hand in a patient with a posttraumatic vasomotor disorder. b, Appearance of hand several weeks after the initiation of treatment. The edema has entirely disappeared.

ures with this method of treatment, since all but a few had an adequate trial of active exercise and physical therapy prior to the institution of the other procedures.

#### *Patients Treated Primarily by Neuro-psychiatric Means*

In 11 individuals definite evidence of some neuropsychiatric disorder was confirmed by psychiatric consultation, although in one of these there was a difference of opinion. This individual made fair progress with active exercise of the affected upper extremity alone but then improvement reached a plateau following which there were still some residual cyanosis, increased sweating and weakness. The complaints of a second patient thought by the psychiatrist to be largely psychosomatic cleared so satisfactorily with ordinary physical

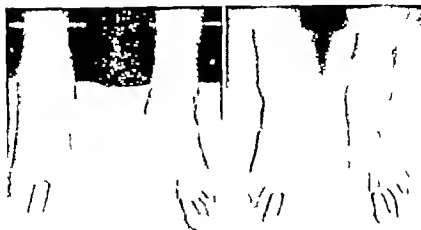


Fig. 1. Sub-acute edema, thrombosis and physical therapy. Left: Edema of right foot upon admission; long nail, month after trivial injury in which small nail fragment penetrated the ankle proximal to the internal malleolus. Right: Appearance of foot 1 year after admission. The internal malleolus is well along the demarcation of the long nail now to appear.

comprehend. The role that disuse was playing in their condition was stressed and the fact was emphasized that a vicious cycle had been set up which would result in continued difficulty so long as inactivity persisted.

In those individuals who had demonstrable edema of an extremity care was taken to attempt to bring this under control before doing anything else. Such patients were put to bed with the extremity elevated until all swelling had disappeared. If this then recurred with activity elastic support was utilized together with periods of rest in bed with the limb elevated. An attempt was made to avoid the return of the edema by limiting activity to a little less than that necessary to cause its appearance. The use of elastic support was continued until swelling was no longer produced by dependency.

In the case of the individuals confined to bed on admission the therapeutic program was aimed at making them ambulatory as rapidly as the circumstances permitted. This sometimes involved a short period with the use of crutches and then a cane before unaided walking could be accomplished. At times widespread petechial hemorrhages appeared in the skin of the extremity when the patient first began to walk after a prolonged period of immobilization of the limb. This response usually cleared up within a short period of

time as activity was increased. If patients were admitted using crutches or canes an attempt was made to have these discarded immediately. Since on first beginning to walk, they generally did so timidly favoring the affected limb careful attention was paid early in the reconditioning program to the acquisition of a normal stance and gait. At times this accomplishment was difficult since most individuals tended to judge improvement by the distance they could cover rather than by the correctness of their gait. However they were made to understand that more benefit was derived from walking a short distance properly than a long distance improperly. Emphasis was placed on the fact that only through the use of a correct gait would all the muscles be brought normally into play and thus undergo strengthening and improvement in tone.

In addition to active use of the limb which was the primary type of physical therapy utilized considerable benefit was obtained through gentle massage and directed active and resisted exercise of all the weak muscles. Passive exercise and manipulation were found to be of little help. In some instances whirlpool baths were utilized but in general no improvement could be observed from this procedure and hence it was omitted in the treatment of the majority of cases. It was necessary

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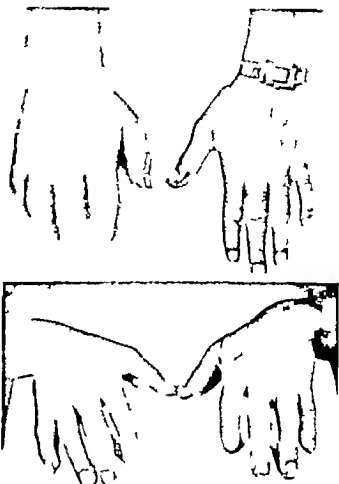


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TABLE II.—EFFECT OF SYMPLECTHOMY IN PATIENTS WITH PERSISTENT EDEMA

Case	Operation, months after injury	Extremity involved	Original injury	Manifestations	Results
		LL	Compound fracture tibia and fibula	Massive edema, leg. Discharged from 2270 C. some small abs. (At trough at bone graft abandoned because of edema)	Edema considerably reduced. No residual bone graft. Foot warm, dry well colored.
		RL	Simple fracture, second and third metatarsal and cuneiform	Marked edema, foot and leg, even with bed rest. Cyanosis, coldness, hyperhidrosis, stocking hyperthermia. Pain on weight bearing requiring crutches.	Edema largely gone. Foot warm, dry well colored. Some pain on weight bearing after walking. Hyperhidrosis improved.
		LL	Foot crushed	Massive edema, foot and leg, persisting with bed rest. Cyanosis, coldness, hyperhidrosis, stocking hyperthermia. Pain on weight bearing. (Conversion hysteria, unaffected by psychotherapy)	Reduction of 1 1/2 in circumference of foot and 1 1/2 in circumference of leg within 4 days. Edema largely subsided. Foot warm, dry. Hyperhidrosis improved. Motor power improved slightly. Could walk with cane fairly well.
		LL	Soft tissue wound, bare	Massive edema, foot and leg, even with bed rest, elevation, and long courses of penicillin and sulfadiazine. Moderate rest pain. Severe local infection. No increased local heat.	Reduction of 1 1/2 in circumference of foot and 1 1/2 in circumference of leg within 24 hours. Edema disappeared but subsequently returned with flare-up of infection, again to disappear with elevation. It has not returned. Pain gone after bed rest. Walks well.
5		RL	Compound fracture tibia and fibula	Massive edema, severe osteomyelitis, ankle	Edema markedly improved. Outcome unsettled.
6		LL	Foot crushed	Moderate edema, foot and ankle, persisting moderate degree with bed rest. Coldness, hyperhidrosis, cyanosis. d h y p e r t h e r m i a. Marked paralytic atrophy. Pain on weight bearing. Bed sores.	Marked improvement. Edema gone except slight after long standing. Temperature normal. Stomach much improved. Foot warm, dry well colored. Slight pain after walking. Walks.
7	5	LL	Soft tissue wound	Marked edema, foot and ankle. Pain on weight bearing requiring cane. Cyanosis. Foot warmer and well. Smoother better than normal side. Weakness and atrophy. Tibial nerve paralysis.	Decided improvement, and finally no symptoms.
8		LL	Compound fracture phalanx	Moderate edema. Pain on weight bearing causing deep C. some hyperhidrosis. Weakness. (Subsequently found to be hysterical)	Little improvement. Some itching and lump still present. Foot warm and dry.

activity that no psychiatric treatment was necessary. His complaints of cyanosis, coldness, swelling, and pain in the foot on weight bearing subsided slowly but steadily, and when he was transferred to a convalescent facility for advanced reconditioning he had no difficulty save for aching in his foot after walking a distance of 3 miles. The 9 remaining patients were treated either by the psychiatrist or in 1 instance by the ward physician under the direction of the psychiatrist. In most cases the procedures consisted of suggestive therapy under amytal narcosis or hypnosis. In all instances, careful and concerted efforts were made to give the patient insight into his condition and to make him understand that he had no organic disorder which would prevent his recovery provided

he continued to push himself to the limit in the active use of the affected limb.

In 4 patients the results with psychotherapy were good in 1 fair and in 4 poor. Two of those in whom no benefit with treatment was observed were transferred to a neuropsychiatric center for more intensive therapy.

One of them was a patient who had complained of swelling, hyperhidrosis, and cyanosis of the feet following compound fracture of the proximal phalanx of a toe resulting from an accidentally self-inflicted wound 9 months prior to admission. His symptoms had not improved with activity but he did obtain a reduction in swelling following a lumbar sympathectomy (Case 8 Table II). In fact he made considerable progress but after returning from a convalescent hospital he still had some swelling and weakness of the foot. It was the psychiatrist's opinion that he had definite hysteria since improved strength in the foot and more normal walking could

be demonstrated under hypnosis. Several subsequent treatments were given but the final result was poor.

The second patient had also been admitted with swelling, cyanosis, weakness, and pain in the foot on weight bearing. He had improved considerably with active exercise and physical and occupational therapy, but following a convalescent furlough he complained of increased weakness and pain and in addition nervousness, anorexia, and insomnia. He had also developed a tremor and some weakness in one of his hands. The psychiatrist felt that he had a definite anxiety state and securing no improvement with amylol narcosis and other treatment recommended his transfer to another hospital.

Of the 2 remaining patients in whom an unsatisfactory result was obtained, one is of interest. In this case, although there was definite evidence of hysteria, no effect was noted from psychiatric treatment. Subsequently, however, considerable though incomplete improvement occurred after sympathectomy (Case 3, Table II).

Of the 4 cases in which the results were considered to be good, 2 will be described briefly.

One was a patient who was admitted to the hospital 4 months after an injury to his right leg sustained when he was kicked during a football game. He had a history of previous trauma to the same limb 1 year before this had been followed by pain, swelling, and cyanosis which decreased slowly and finally disappeared. Within a few days after his recent injury he noted a return of these symptoms. They increased in severity so that he could walk only with the use of crutches. He had received a series of 10 sympathetic blocks with some transient improvement in the strength of the affected foot. On examination of the patient it was evident that he was unwilling to do very much for himself. He appeared apprehensive and was rather jumpy while being questioned. He exhibited apparent marked paresis of all the movements of the foot and ankle, but such efforts were associated with tremor and with tonic contractions of antagonistic muscles. The psychiatrist felt that this patient had hysteria and gave suggestive therapy under amylol narcosis. During this procedure the foot which had been cold, wet, and markedly cyanotic, became warm, dry, and of good color. The patient could move it freely and strongly through a full range of motion. He was made to walk and did so with practically a normal gait. After this single treatment and following further explanation regarding the nature of his progress, he made daily improvement. When he was discharged after a month's hospitalization, his foot was normal in color and warmth, had no swelling, showed only slight reduction in motor power, and had a normal

range of action. The patient had no pain except after walking a mile and a half. There was no improvement in the moderate osteoporosis which was present on admission.

The second patient was admitted to the hospital 4 months following shell fragment soft tissue injuries to his left thigh and leg. There had been immediate paralysis and numbness of the foot with return of flexion and of sensation on the sole 6 weeks later. Upon admission the patient complained of swelling, cyanosis, coldness, and sweating of the left foot and tingling and aching pain on attempted weight bearing. He walked with crutches. Examination showed cyanosis of the foot, reduction in skin temperature, moderate hyperhidrosis, marked paresis of eversion and complete loss of extension of the foot and toes. There was some hypesthesia of the foot with anesthesia in the distribution of the saphenous and the lateral sural nerves. The neurosurgeon had no doubt that the patient had a sciatic nerve injury with partial peroneal paralysis. Efforts at active use of the limb with a foot-drop brace were futile, and since a fairly good response was obtained with a sympathetic block, a lumbar sympathectomy was performed (Case 2, Table III). Following this procedure the patient showed definite improvement and bore weight with the use of crutches; he discarded these for a cane after 1 week. The foot was warm and dry and there was only minimal edema in the leg and none in the foot. Less pain was present on walking. Two months later the sciatic nerve was explored and was found to respond well to faradic stimulation. A week after operation a psychiatric consultation established a diagnosis of hysteria. Following a single amylol interview the patient regained all movements, had a return of sensation, and walked unaided normally and without pain.

This case illustrates most emphatically the necessity for keeping in mind the possibility of a psychiatric basis for such complaints and of instituting the proper therapy before attempting other more heroic procedures.

#### *Patients Treated by Sympathetic Block*

Thirty-two patients had received sympathetic blocks prior to their admission to the Mayo General Hospital. This procedure had been carried out on an average of 6 months after the onset of the disorder, with a range of from 1 to 22 months. From 1 to 28 blocks had been given to each individual. Upon analyzing the results of these efforts from the notes in the medical records and from questioning the patients, it appeared that 12 patients noticed no change except in some temporary elimination of coldness, cyanosis, and sweating during the period of anesthesia, while



in 13 there appeared to be definite but transient benefit from the procedure. In 4 there was evidence that slight or moderate permanent improvement had resulted and in 3 good permanent results were obtained.

In assaying the value of sympathetic blocks from this material it must be recognized that in a few instances effective anesthesia of the sympathetics had not been achieved as was evidenced by the fact that the foot or hand remained cold and wet following the injection. In others the possible therapeutic effect upon walking was compromised by associated inadvertent blocking of somatic nerves resulting in temporary anesthesia and paralysis, which prevented the use of the lower extremities during the period of effective sympathetic block. Furthermore in most of the patients it was apparent that no effort had been made to have the patient walk or otherwise actively exercise his affected limb immediately after the injection. In addition in very few of the individuals who noted some benefit over a period of hours or days following the procedure was advantage taken of this improvement by insistence upon progressively increasing the use of the limb. There is no question that if sympathetic blocks are to achieve the maximum benefit the involved extremity should be subjected to weight bearing and walking or other active exercise immediately after the injection, and that this should be continued to the point of tolerance. Only by such a plan can the effectiveness of the procedure be properly evaluated.

When the patients came under our care a number of them received sympathetic blocks, but these were done primarily as a preliminary procedure to determine the advisability of sympathectomy. However in 7 individuals the blocks acted as a therapeutic measure. Two of them had a syndrome characterized by coldness, hyperhidrosis, and weakness of a hand, one had rather marked edema of the hand without any other significant changes, while the 4 others demonstrated edema, coldness, cyanosis, and hyperhidrosis of the affected foot. The treatment was instituted from 6 to 12 months following injury. Three of the patients received only a single sympathetic injection and 4 were given 2 treatments.

All of them had a definite steady improvement following the blocks, such as marked diminution in coldness, hyperhidrosis, and edema, return of good color and improved motor power and function. Each individual had previously been making a definite effort to use the extremity actively to the best of his ability but without any apparent improvement and there was little doubt from the sequence of events that the block rather than the other therapeutic efforts was primarily responsible for the altered clinical picture. It is of interest that pain was not a prominent complaint in any of the patients who underwent lasting improvement as a result of sympathetic blocks.

#### *Patients Treated by Sympathectomy*

Thirty five sympathectomies were performed upon 34 individuals. Three of them have been included in the section on "Patients Treated Primarily by Neuropsychiatric Means" but are again analyzed here for the sake of completeness. Lumbar sympathectomy was carried out under spinal anesthesia through an anterior extraperitoneal approach. The second and third lumbar sympathetic ganglia, with the intervening chain were excised. Sympathectomy of the upper extremity was performed through a posterior muscle-splitting incision with resection of a portion of the third rib and the transverse process. The second and third thoracic ganglia were decentralized, the chain severed between the third and fourth ganglia, and the isolated segment was encased in a silk cylinder. This was accompanied by intradural section of the second and third anterior nerve roots and extradural section of the corresponding posterior roots. No complications occurred in any of the patients.

Decision to perform the operation rested upon a number of factors. In the case of patients with ulcers, surgical intervention was based primarily upon the chronicity of these lesions and the presence of associated vasospasm. Sympathetic procaine anesthesia proved a reliable test for judging the result which could be expected from sympathectomy in those individuals with evidence of excessive sympathetic activity. Where edema was present, the response with procaine block was

variable. In a very few patients a demonstrable transient diminution in swelling was evident following the block, while in a number of others it was necessary to determine whether the increase in the size of the extremity occurring during a period of an hour's walking immediately following the injection was less than that observed during a comparable interval on another occasion. In most of the patients with edema, however, no convincing evidence could be derived from sympathetic blocks as to whether or not a good result would be obtained from sympathectomy. Nevertheless the therapeutic effect of sympathectomy was frequently satisfactory in these individuals.

Where pain was the primary indication, the study during sympathetic anesthesia likewise yielded variable results. In some cases as soon as the injection had been completed the patient was surprised to find that he could move the affected part freely through a wide range of motion without pain. Furthermore he could walk or otherwise exercise the extremity with either no pain or with much less discomfort than was present previously. In such instances there appeared to be good evidence that sympathectomy would be effective. In others, however, sympathetic anesthesia had no beneficial effect upon the pain associated with exercise, and again in them a much better result frequently followed sympathectomy than would have been predicted from the preliminary studies.

For the purpose of analysis the patients subjected to sympathectomy have been divided into 4 groups according to the primary indication for operation, namely those with considerable persistent edema, those with pain on walking, those with evidence of excessive sympathetic activity, and those with chronic skin ulceration. This division is somewhat arbitrary in the sense that rarely were symptoms limited to any one of the categories. For example, some of the patients with edema likewise had pain on weight bearing and evidence of vasoconstriction, while in the case of those whose chief complaint was pain on weight bearing, such findings as excessive vasomotor tonus and slight or moderate edema were also present. Similarly, the individuals

with chronic ulceration had evidence of increased sympathetic activity, edema and discomfort on walking. It is felt, however, that this division serves a useful purpose in presenting the results in a more concise fashion.

In Table II are summarized the data upon 5 patients who were operated upon primarily because of persistence of edema. The procedure was carried out from 4 to 11 months following injury, with an average of 5.0 months. In 1 individual the edema was only moderate and in 1 it was marked and in the 6 remaining it was massive. All of the patients had had a trial of bed rest with elevation of the affected limb and of elastic support on becoming ambulatory. In 6 individuals the edema persisted with bed rest alone and in 4 of these subsidence had not occurred even with a prolonged period of elevation. There was evidence of vasospasm in 6 and in 1 in whom infection was present there was definite local hyperemia (Case 4).

In 1 of the patients in the group (Case 1) in whom swelling was associated with an ununited fracture of the tibia, exploration for a bone graft had been carried out, but the procedure was abandoned because of the marked water logging of all the tissues. There was considerable reduction in the edema following sympathectomy and when the bone graft was subsequently undertaken, the operator judged that the condition had improved by about 90 per cent. Another patient with extreme swelling (Case 5) associated with a compound fracture and osteomyelitis of the ankle had only slight improvement after operation.

A third individual with edema requires brief discussion.

He was a patient who had sustained a soft tissue shell fragment injury of his left foot (Case 4). The foot and leg were enormously swollen and local infection was present (Fig. 3, a and b) associated with fever and weight loss. Intensive treatment consisting of repeated debridement and incisions and drainage, prolonged sulfonamide and penicillin therapy, and immobilization and elevation of the limb had brought about no improvement whatsoever. A sympathetic block caused no demonstrable diminution of the edema but effected a transient subsidence of pain. Sympathectomy was performed 5 months after the injury and within 36 hours the circumference of the foot had been reduced by 1½ inches and that of the leg by 4½ inches. Within the next few



Fig. 3. Subsidence of edema and healing of ulcer following sympathectomy. a, b, Massive edema of left foot and leg in patient with a posttraumatic vasomotor disorder and infection, resistant to treatment. No improvement

derived from continued bed rest, elevation of the extremity and sulfonamide and penicillin therapy. c, End result following sympathectomy. The ulcer has healed and there is no edema.

days the edema cleared up completely as did the infection and healing occurred so that only a tiny ulcer remained. The patient subsequently had a reactivation of his infection with a transient recurrence of swelling. This however responded well to elevation and rest following which the wound healed completely (Fig. 3 c) the edema disappeared entirely and the patient could walk normally and with comfort.

The 5 remaining cases in the group with edema presented other signs and symptoms more commonly seen following injury. An inability to bear weight properly because of pain was present in 4 while the remaining patient walked with a decided limp. All complained of weakness, 1 had virtual paralysis, and 3 demonstrated hypesthesia. Three of the 5 had signs of intense sympathetic hyper-tonus, with coldness and hyperhidrosis. A fourth had persistent hyperhidrosis and cyanosis and the fifth had a cool foot which however was warmer and demonstrated greater oscillations than the contralateral normal limb. Three of these patients showed either complete or partial subsidence of edema following sympathectomy (Cases 2, 6 and 7). They could now walk better and without discomfort for a greater distance than before operation. The hypesthesia was improved or was no

longer present. One of these individuals (Case 7) was observed for some months, and no signs of swelling recurred during this period. The 2 remaining patients have been mentioned previously. One had some transient improvement in the edema following sympathectomy but was eventually recognized to have a conversion hysteria which responded poorly to psychotherapy (Case 8). The other case is instructive because it illustrates the therapeutic effect of sympathectomy in a hysterical individual who also showed a poor response to psychotherapy (Case 3).

Following a crushing injury of the left foot he had marked swelling, coldness, hyperhidrosis, and hypesthesia (Fig. 4, a). There was almost complete paralysis. No improvement was noted following interviews with the psychiatrist and no effect was observed with a sympathetic block other than transient warmth and dryness of the foot. Eleven months after his injury sympathectomy was performed. The edema which had persisted with bed rest and elevation virtually disappeared within 48 hours after operation. The individual was converted from a bedridden to an ambulatory patient (Fig. 4, b) although he walked with a limp and required a foot-drop brace and a cane. Further psychotherapy was found to be of no avail and since a plateau had been reached he was separated from the service.



Fig. 4. Subsidence of edema following sympathectomy. a. Left. Edema of left foot in a patient with hysteria and a posttraumatic vasomotor disorder of 12 months duration taken after 3 weeks of continuous bed rest with elevation of the extremity. Poor response followed psych therapy. b. Appearance of foot 30 days after lumbar sympathectomy. Edema has almost completely disappeared.

In Table III are summarized results of sympathectomy in 10 patients who complained of pain on weight bearing and in 2 who had pain at rest. At the time of operation 1 had been confined to bed and refused to become ambulatory, 5 walked with the aid of crutches and 2 with canes. The 4 remaining walked with a limp and favored the injured limb. Nine had definite evidence of intense vasospasm and cyanosis was present in all 12. Nine had slight or moderate edema.

The results with sympathectomy were excellent in most of the patients who had pain on weight bearing. One of these individuals who had moderate improvement after sympathectomy has already been mentioned. He was subsequently found to have hysteria and obtained a complete cure after one amygdalotomy (Case 2). Of the remaining patients some were now able to walk several miles before the onset of discomfort while in others there was no residual pain at all. The 2 individuals who had burning rest pain also showed definite improvement in this complaint. In the group as a whole edema either disappeared or was now present only in a slight degree even after prolonged dependency. All of the individuals had warm dry feet and only 1 showed some residual cyanosis. Muscle strength improved and by the time the patients left the hospital there was

an increase in the size of the muscles in several instances where definite atrophy had previously existed. It must be pointed out that except for a few of the early cases the patients in this group had been subjected to a rigid regimen of active exercise prior to operation but with no definite relief in symptoms. Even the several patients who followed no planned program of calisthenics had been encouraged to walk and exercise their affected limb.

In Table IV are summarized the results of sympathectomy in patients with excessive sympathetic activity. Thirteen operations were done upon 12 individuals. Eight were dorsal and 5 were lumbar sympathectomies. Ten of the patients had previously complained of excessive coldness generally associated with both cyanosis and hyperhidrosis under ordinary environmental temperatures and 6 had definite cold sensitivity manifested by marked coldness, stiffness, and discomfort on exposure to a low temperature. The 5 patients with involvement of the lower extremity all had slight or moderate edema and 1 of them also had pain on weight bearing. One of the individuals who had an amputation of a finger had moderate phantom limb symptoms (Case 7).

Complete relief occurred following operation in 7 patients while the 5 remaining were much improved. In each instance in which it

TABLE III.—EFFECT OF SYMPATHECTOMY IN PATIENTS WITH PAIN ON WEIGHT BEARING OR ON REST

Case	Operation, months after injury	Extremity involved	Original injury	Manifestations	Results
1		LL	Foot crushed	Pain on weight bearing requiring crutches. Marked edema, cyanosis, hyperhidrosis, moderate atrophy. Atrophy calli	Wells without sleep and only slight pain after prolonged walking. Feet warm, dry well colored
		LL	Soft tissue wound, thigh	Pain on weight bearing requiring crutches. Coldness, cyanosis, hyperhidrosis, slight edema. Apparent peripheral palsy; atrophy calli	Moderate improvement in pain. Walks with case. Feet warm, dry well colored. Subsequently found to have lysis. Complete cure, including motor and sensory return, after simple neural anastomosis
2		RL	Pericarditis, riba	Pain on weight bearing requiring crutches. Coldness, cyanosis, hyperhidrosis. Atrophy calli	Complete relief
3		LL	Soft tissue wound, foot	Pain on weight bearing requiring crutches. Moderate edema, cyanosis, weakness and atrophy calli	Moderate improvement on weight bearing. Walks without case but keeps stiff some pain. Feet warm and dry. Edema less
		LL	Soft tissue wound, foot	Pain on weight bearing requiring crutches. Coldness, cyanosis, slight edema. Atrophy calli	Much improvement. Pain only after walking 3 miles or more. Feet warm, dry well colored. Edema was first reduced then disappeared
4		L	Simple fracture, metatarsal	Pain on weight bearing causing limp. Slight edema, cyanosis, weakness, coldness, and atrophy	Much improvement. Pain after walking 3 miles. Edema less. Feet warm and dry. Foot stronger
		LL	Chip fracture second and third phalanges	Pain on weight bearing requiring case. Slight edema, cyanosis, weakness	Steady improvement and then complete relief
5	6	RL	Soft tissue wound, foot	Pain on weight bearing. Moderate edema, cyanosis, reduced sensibility very atrophy and weakness	Much improved. No discomfort until walking more than 1 mile. No edema. Feet warm and well colored
6		RL	Soft tissue wound, foot	Pain on weight bearing causing limp. Marked edema, cyanosis, hyperhidrosis. Weakness and atrophy	Marked improvement. No discomfort until walking more than 1/2 mile. Feet warm, dry well colored
		RL	Foot crushed	Pain on weight bearing requiring case. Slight edema, coldness, cyanosis, hyperhidrosis. Weakness, trophy, hyperhidrosis	Much improved. Able to walk 3 miles without pain. Feet warm, dry, well colored. Still slight edema. Feet stronger. Sensation normal
7		RL	Compound fracture	Moderate burning rest pain, increased with dependency. Moderate edema, cyanosis, coldness	Much improved. Pain much less. Edema less. Feet warm. Slight cyanosis in dependency
		RL	Simple fracture	Moderate burning pain at rest, cyanosis, coldness. Partial peripheral palsy	Much improved. Pain much less. Feet warm, dry well colored

existed cold sensitivity was diminished. The limbs were dry warm and well colored. Hypesthesia which had been present in 1 patient was considerably improved (Case 4). Two individuals subsequently required corrective operative procedures upon the affected limb which were followed by prompt healing of wounds (Cases 1 and 2).

In Table V are summarized the data concerning 2 patients for whom the operation was performed primarily because of the persistence of chronic ulcers<sup>1</sup> (Fig 5 a). In both repeated efforts at skin grafting had failed

but healing occurred fairly promptly after sympathectomy (Fig 5 b). In 1 individual (Case 2) it was apparent before sympathectomy was performed that transfer of full thickness skin would eventually be required, but it was felt that the chances of success would be enhanced if this could be done after epithelialization of the ulcer and correction of the vasospastic disorder.

In the case of all patients treated by sympathectomy strenuous active exercises were insisted upon after a short period of convalescence. It was the common experience that this could be accomplished better and with little or no discomfort after the operation,

<sup>1</sup>In 2 other patients chronic ulcers healed satisfactorily with rest and saline compresses.



Fig 5. Healing of chronic ulcer following sympathectomy. a, left. Ulcer of leg in a patient with a posttraumatic vasomotor disorder of 1 year's duration. Bed rest, compresses locally small deep grafts, and split thickness grafts had failed to bring about healing. b, Seven weeks after sympathectomy. Almost complete healing of ulcer has occurred.

and that steady subsequent improvement occurred as the individual continued to take advantage of his increased ability to perform physical exercise.

#### *Effect of Treatment upon Osteoporosis*

In 24 cases roentgenograms made at the time of admission and then some months after institution of treatment, were available for study. In 11 of the patients no alteration in the degree of osteoporosis was noted during their hospital stay. In this group the original films showed slight osteoporosis in 2, moderate in 8, and marked in 1. They had been taken from 3 to 14 months after the initial trauma, with an average of 8.8 months, while the final roentgenograms were obtained from 4 to 17 months after the injury, with an average of 10.5 months. There was thus an average elapsed time interval of observation of 1.7 months.

The 13 remaining patients in the group demonstrated definite improvement in regard to osteoporosis. The original films were taken from 2.5 to 6 months after the initial trauma, with an average of 4.9 months, while the ones first revealing a reversal toward the normal state were obtained from 5 to 12 months after injury. Thus there was an average interval

of 4.1 months between the original films and those indicating improvement. The first roentgenograms showed slight osteoporosis in 1, moderate in 6, and marked in 6. Of the 6 patients originally demonstrating marked changes, 1 showed normal bone structure in the final film, 4 had only moderate osteoporosis, while in 1 there was only a slight improvement. In 3 of the 6 individuals who initially had moderate osteoporosis, evidence of only mild involvement was now present, while in the other 3 the roentgenograms revealed a normal or almost normal condition. The 1 patient who had slight osteoporosis originally had normal appearing bones on the last examination.

In comparing the type of treatment with the changes in osteoporosis, it is of interest that 4 of 9 patients treated by exercise, physiotherapy, or psychotherapy and 9 of the 15 sympathectomized individuals showed some improvement in this state. Two of the patients treated by sympathectomy in whom no change in the degree of osteoporosis was subsequently observed had sustained fractures of long bones requiring prolonged immobilization before operation, and it is possible that the factor of continued disuse may have played a role in the persistent osteoporosis.

TABLE IV. EFFECT OF SYMPHETECTOMY IN PATIENTS WITH ENCL IN SYMPATHETIC ACTIVITY

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For several reasons we have purposely limited this study to an analysis of our experience with military personnel treated in a vascular center. The advantage of using only soldiers in the investigation lies in the opportunity which was afforded to follow them carefully for as long a period of hospitalization as was required. Furthermore in all of them the same motive was present with regard to the possible rewards arising from continued disability. In contrast in a comparable but smaller group of civilian patients whom we have studied much more difficulty was encountered in attempting to analyze the results. The individuals varied considerably in

age and in fact is tending to make profitable or futile the persistence of complaint. Most of them were hospitalized for only short periods. Time and our observations were limited to those intervals and to office visits. In general, however, experiences with our civilian and military patients have complemented one another. The manifestations of the post-traumatic disorders and the results of treatment have been much the same in both groups.

The main point of interest regarding therapy which can be derived from the present study is that the degree and duration of physical disability is associated with posttraumatic vasomotor disorders are dependent in great part upon the amount of time that elapses between

TABLE V—EFFECT OF SYMPATHECTOMY IN PATIENTS WITH CHRONIC ULCERS

Case	Operation, months after injury	Extremity involved	Original injury	Site of ulcer also	Other data	Results
		RL	Simple fracture tibia and fibula, evulsion of skin	Over internal malleolus 22 cm.	Split, sliding full thickness and pedicle grafts had failed. Pain on weight bearing; edema, cyanosis and reduced oxidimetry. Foot cool but warmer than normal one	Ulcer healed rapidly and remained healed. Walking much improved, foot warm, dry of good color. Edema improved
		LL	Compound fracture fibula	Lateral surface leg 42 3/4 cm.	Small, deep and split grafts had failed. Aching rest pain; pain on weight bearing; edema, cyanosis, coldness and hypaesthesia.	Ulcer healed rapidly. Subsequent transfer graft. Foot warm, dry well colored; hyperaesthesia gone; edema less; no pain on weight bearing

the onset of the condition and the initiation of active and effective therapy. In most of our patients early therapy was negligible and as a result, distressing sequelae persisted for many months necessitating prolonged hospitalization. In contrast was the generally satisfactory course of events in our civilian patients who were treated actively soon after injury. The period of incapacitation was much less especially when possible financial compensation was not a factor in the case.

After a period of disuse certain changes take place which are exceedingly difficult to correct. Among these are osteoporosis, muscle atrophy and a rather fixed mental attitude which hampers return to normal activity. The last factor may be due either to fear of discomfort, discouragement concerning recovery, some motivation to prolong the disability as desire for compensation or other rewards of invalidism, such as avoidance of duty in the Army.

A patient with a painful or edematous extremity or one with distressing coldness and hyperhidrosis has a strong urge to keep it at rest. Disuse itself may bring about a reduction in blood flow, coldness, cyanosis, hyperhidrosis, edema, and osteoporosis, all alterations which are also part of the posttraumatic syndrome. As a consequence, it is often difficult to evaluate the relative roles of the trauma and the reflexes initiated by it, on the one hand and of the resultant disuse on the other.

It is also important to keep in mind the fact that emotional stress and instability and certain of the more clear-cut neuropsychiatric conditions are often associated with increased sympathetic activity, and that not infre-

quently those who have sustained an injury may bring such emotional and psychiatric mechanism into play. It is necessary therefore to take into consideration the factors of disuse and psychiatric manifestations in any study of patients with posttraumatic vasomotor disturbances.

Numerous individual reports testify to the value of various therapeutic measures such as voluntary motion and weight bearing (13), procaine sympathetic blocks (5, 7), penateinal sympathectomy (1, 3, 4, 6, 7), and excision or procaine infiltration of painful scars or thrombosed vessels (5, 9). Local anesthetization of the injured area seems to be not only of value in treatment but possibly also in preventing the development of posttraumatic disorders (7, 12). Unfortunately it is impossible to establish from the data recorded in the literature the incidence of failures with the various methods of treatment. Our own experience, both with civilian and military patients, emphasizes the importance of evaluating carefully all possible therapeutic aids in any given case and of neglecting no useful adjunct in treatment.

#### SUMMARY AND CONCLUSIONS

Although patients who have sustained trauma to an extremity ordinarily only have symptoms which are due to the local tissue injury, a certain number have superimposed upon these complaints additional manifestations which can be explained only on the basis of some reflex activity initiated by the trauma. These difficulties fall into the category of posttraumatic vasomotor disturbances. The present report deals with a series of 142 soldiers suffering from such afflictions.



Generally in our patients the initial clinical picture was that of intense vasomotor activity and later this finding was almost invariably present. The primary manifestations in the acute stage were predominantly those of pain and swelling although in a lesser number they consisted of coldness, hyperhidrosis and cyanosis. Later in the disease the commonest complaints were those of pain on exercise and weight bearing and swelling. Coldness, cyanosis, and hyperhidrosis were frequently noted and in some patients, a distressing cold sensitivity. Many individuals had edema present at rest, or more often when the limb was dependent. In those in whom skin had been denuded ulceration tended to persist.

With regard to early therapy the conclusion was reached that proper care should be given to the local injury itself such as débridement, removal of foreign bodies, reduction of fracture, and the active treatment of infection. Although it is important to utilize immobilization and bed rest when the local trauma necessitates such measures, for the most part as early immobilization as is possible is advisable. In fact, some individuals can overcome the posttraumatic syndrome shortly after injury by simple perseverance in forced active exercise. It is essential to instill in the patient confidence in his ability to make a satisfactory recovery to eliminate any tendency toward chronic invalidism and to correct any existent psychiatric ailment.

In many patients, however such simple expedients do not prove to be satisfactory therapeutic measures and hence other procedures must be utilized. Among these is procaine sympathetic block, which not uncommonly eliminates pain as soon as the injection is completed causes the extremity to assume a normal color and results in the disappearance of hypesthesia and improvement in motor function. Although often a single injection may be sufficient, in some patients a series of blocks is necessary. If repeated sympathetic blocks produce a good but transient effect, sympathetic ganglionectomy may result in a permanent cure.

In the treatment of the later stages of posttraumatic vasomotor disorders, the situation is complicated both by the fixed mental atti-

tude of the patient which is that of the chronic invalid and the extensive atrophy and motor weakness which undoubtedly result not only from the initial difficulty but also from the superimposed disuse. It is important to utilize psychotherapy in encouraging continued and gradually increasing active exercise of the affected limb and to employ more specific psychotherapeutic measures in those instances in which psychiatric factors are a definite accompaniment, if not the primary basis, for disability. Regardless of any other type of treatment it is important to avoid edema by a period of bed rest and elevation of the limb if necessary and the use of elastic support. In general sympathetic blocks are of little avail as a therapeutic means when the syndrome is of long duration, but they may prove very useful in some instances, particularly where the manifestations are primarily edema or evidence of increased sympathetic activity. If the above means of treatment have been given adequate trial and yield unsatisfactory results sympathectomy should be considered. In properly selected cases it results in excellent recovery. In the treatment of the late manifestations the duration of therapy is necessarily longer and a more intense program is required than in the early phase of the posttraumatic disorders. In addition, there is considerably less likelihood of a completely successful outcome.

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# CARCINOMA OF THE VULVA

## Report of 313 Cases

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CANCER of the vulva is considered to be a relatively rare malignant tumor. From our records of approximately 8,000 gynecological malignant tumors, the incidence of cancer of the vulva is 3.88 per cent of all cancers of the female genitalia. As shown by Pack, the incidence is only one half of one per cent of the total number of cancers, or 3.2 per cent of all cancers of the female genitalia. A review of the cases brought forth in the literature during the past 3 decades reveals an apparent great increase in this type of malignant growth, an increase which may be real or may represent merely a relative increase in the total number of patients admitted to the various institutions as a result of the wide dissemination to the lay people of information concerning cancer; it may be the result of increased knowledge about the disease among the medical profession, or it may be because the average age of the population has increased during the past 30 years.

Schreiner and Wehr reported 118 cases of carcinoma of the vulva from this hospital during the period from 1913 to 1933 inclusive. They gave in the 5 year free of disease category 72 cases from 1913 to 1928. From 1933 to 1947, 195 additional cases of carcinoma of the vulva have been seen at the Roswell Park Memorial Institute. In this paper we shall consider first, for general statistical purposes, the total number of patients, 313, admitted from 1913 to 1946, and second, in order to evaluate the results of treatment, we shall report the results in 170 patients admitted from 1929 to 1941, so as to obtain the 5 year end results.

The average age at admission for the 313 patients was 61.5 years. This figure agrees

with the average age of 60 reported by Pack for 117 patients. The peak age incidence in relation to the 1940 census of New York State, fell between 70 and 74, 65 per cent of the patients being in the age group 50 to 75, 16 patients, or 5.1 per cent, were below the age of 40, while 40 patients, or 12.8 per cent, were above the age of 75. The youngest was 6 and the oldest 96.

The most common age of menarche in the series was 14, the youngest 9 and the oldest 28. This is an average distribution and gives no indication of a relationship between menarche and cancer of the vulva. The weighted mean age of menopause was 48. However, a menopausal age distribution curve showed a peak at 52, the youngest being 32 and the oldest 64. Eighty per cent of the patients had passed the menopause, which indicates that carcinoma of the vulva is predominantly a postmenopausal or so called degenerative disease.

Considering the marital status of this group of 313 patients, it was found that 284 were married, 247 having borne children or miscarried, while only 29 were single. This is a ratio of 10 to 1 of married to single.

An interesting point concerning the various nationalities and races of the patients was observed. There were no women of negro or Jewish extraction found in the entire series of 313 cases.

The primary complaint occurring in 160 patients was itching and pruritus. The next commonest, occurring in 122 patients, was swelling or perception of the lesion by the patient herself, causing her to seek medical care. Discharge, pain and bleeding were found to be relatively infrequent primary symptoms. Leucoplacia was present in only 12 per cent of the cases, which is considerably less than that reported in other series of rela-

TABLE 1—DISTRIBUTION OF CASES OF CARCINOMA OF THE VULVA (ACCORDING TO AGE OF ADMISSION)

Age—Years	Number admitted	Female population New York State (1929 census)	Rate per 10,000
to 4			
5 to 9			
10 to 14			
15 to 19			
20 to 24		301,536	
25 to 29		646,034	0.3
30 to 34	4	398,402	0.073
35 to 39	0	517,084	0
40 to 44	20	130,131	3
45 to 49	9	479,341	30.46
50 to 54	5	205,417	24
55 to 59	5	326,518	15
60 to 64	43	264,706	8
65 to 69	36	207,450	43
70 to 74	30	147,781	40
75 to 79	40	464	
80 to 84	16		
85 to 89			
90 to 94			
95 to 99			

tive size (Smith and Pollack and Taussig 5 6) Only 4 patients were diabetic and 3 had positive Wassermann reactions which seems to indicate that syphilis and diabetes have very little or no bearing on the etiology of cancer of the vulva.

The duration of symptoms before admission to the institute varied widely from 1 month to several years, but it has been observed that the duration of symptoms during the past decade is markedly less than in the previous decades also that the lesions are not as far advanced as they were 10 20 and 30 years ago.

The histological forms or types present in this series were as follows: epidermoid carcinoma, 300 malignant melanoma 7 adenocarcinoma, Bartholin's gland 1 myosarcoma, 1 and basal cell carcinoma 4.

The classification given shows that over 95 per cent of vulvar cancer cases observed in this series were epidermoid in origin. This percentage is somewhat higher than that re-

ported in the literature. Smith and Pollack reported 84 per cent of epidermoid carcinoma in their series of 228 cases. Taussig (6) in his series reported 90 per cent. The percentage of malignant melanomas found in this series was 2.2 per cent which closely approximates the average percentage found in other series of the same type. Adenocarcinoma, Bartholin's gland origin and sarcoma of the vulva are very rare. This series showed 1 case of each. Only 16 patients of the 313 (5.1 per cent) had other primary malignant tumors.

The youngest and the most interesting case in this series was a 6 year old child with a myosarcoma of the vulva. This patient had been to her family doctor in March 1944 1 month after the appearance of the lesion. The child was hospitalized and the tumor mass was removed. It was reported to be myosarcoma. There was an immediate recurrence, eventually involving the entire labia majora. The patient was admitted to the Roswell Park Memorial Institute July 1944 5 months after the original appearance of the lesion. Clinically this growth involved the fourchette and left labia. The mass was excised and roentgen therapy was given. A pathological section from the vulva showed a malignant tumor made up of large and small spindle cells. When last seen 4 years later there was no evidence of disease and the general condition of the patient was good.

It has been customary at this Institute to use a simplified classification consisting of three groups as follows:

Group I—Included those patients who were admitted here without any form of previous treatment, and in whom the disease was confined to the vulva, regardless of its size.

Group II—Included those patients admitted without previous treatment in whom at the time of admission the lymph nodes in one or both groins were distinctly enlarged and firm and were believed to be metastatic.

Group III—Included all patients with vulvar disease who had received treatment, surgery radiation or a combination prior to admission here.

The 72 patients treated from 1913 to 1928 inclusive, on whom Schreiner and Wehr reported 5 year end results, were divided into

the same clinical groups. The results are as follows

	Total	N.E.D.	Percent- age
Group I	19	6	31.5
Group II	24	0	0.0
Group III	39	2	7.0
	72	8	11.1

N.E.D. no evidence of disease.

The present paper reports the 5 year end results in 170 patients treated from 1929 to 1941 inclusive, with larger doses of more heavily filtered radiation plus more extensive surgery. In all of these patients vulvar cancer was proved by histological section. Prior to 1929 very few patients had more than local excision or local coagulation of the lesion. Subsequent to 1929 an increasing percentage of the patients had total simple vulvectomy with the metastatic nodes being treated with irradiation. Since 1941 more radical surgery is being used, consisting of total vulvectomy and superficial groin dissection, unilateral or bilateral when there are definite inguinal nodes which are thought to be metastatic when there are no definite nodes or when there are soft tender nodes which are thought to be inflammatory, groin dissections are omitted. These patients are followed closely and if the soft tender nodes regress, no groin surgery is performed. We have not used the so called Taussig or Basset type of radical groin dissection in any case of carcinoma of the vulva and note that Smith and Pollack conclude that best results in their cases were obtained when a vulvectomy with bilateral superficial groin dissection without removal of the iliac or deep inguinal nodes was performed.

In the inoperable cases, whether inoperable because of the disease or because of the patient's poor general condition and in post operative recurrent cases whether the recurrence be local or in the nodes x ray therapy is used and often gives marked prolonged relief and occasionally apparent cure.

The 5 year end results are shown in Table III. It can be observed from this table that there is a marked increase in the cure rate in all 3 clinical groups as compared with the previous report of Schreiner and Wehr. This may be attributed to the more radical surgical

TABLE II.—COMPARISON OF METHODS OF TREATMENT

Group I			
	Coagulation or surgery	Radiation	Combined surgery and radiation
No evidence of disease	5		
Alive with disease			1
Died of disease		3	
Lost			1
Died of other causes		1	4
Total	6	4	18
% Cure rate	81.4		55.5
Group II			
No evidence of disease	0		0
Alive with disease			1
Died of disease		5	3
Lost			
Died of other causes	0		
Total		7	4
% Cure rate			20.9
Group III			
No evidence of disease			10
Alive with disease			3
Died of disease			3
Lost			
Died of other causes			
Total		3	17
% Cure rate			23.5

procedures and to the increased radiation dosage used subsequent to 1928. However to make a comparative study of the relative merits of surgery and radiation, the data appearing in Table II were rearranged according to the 3 methods of therapy, surgery alone radiation alone, and a combination of both. It will be noted from Table II that of the 48 patients of group I 6 received surgery alone 4 received radiation alone and 38 received a combination of both. While the numbers 6 and 4 are too small to yield results to which any significance can be attached the results are highly suggestive that surgery is far superior when one considers that 5 of the 6 patients treated with surgery alone survived while on the other hand none of the 4 patients

TABLE III—FIVE YEAR END RESULTS

	Number admitted	Number treated	Number free of disease	Alive with disease	Died of disease	Lost	Died of other causes	Cure rate absolute %	Cure rate relative
Group I	48	48	36		5		5	54	32
Group II		79		3	59			5	
Group III	30	28	16	3	3			36	26.3
Total	78	164	4	7		4	7	36	37

treated with radiation survived. This is further substantiated when considering the 27 patients in group II who received radiation only and yielded no survivors.

Evaluating the combined therapy of the 38 patients in group I 32 received radiation to the groin only the primary site receiving none at all. This would seem to indicate that the radiation was administered for prophylaxis only and its role in the ultimate result of the treatment is difficult to analyze. On the other hand when considering the corresponding group II cases, that is the group which received treatment in the form of surgery and radiation we find that here the radiation to the glands had a definite effect in improving end results because all of these patients had nodes and in no case did the surgical procedure touch the gland-bearing region. Therefore it would seem logical to conclude that the radiation must have been beneficial in controlling the disease.

The question has been raised by Smith and Pollack as to the role of the pathological grading of the disease in relation to end results. Their figures tended to prove a higher cure rate for the pathological grade I or well differentiated tumors as compared with grades II and III or the less well differentiated tumors. Of the 170 cases considered in Tables II and III which had proved positive sections, there were 147 which the pathological department could grade using a modified Broder's classification.<sup>1</sup> The grading and end results of the 147 cases which could be graded are shown in Table IV. All patients who were alive with disease or who had been lost or died of other causes within the 5 year period are included with those who died of the disease thus giving an absolute cure rate for the different pathological grades.

<sup>1</sup>Broder's Grades II and III combined.

It seems from Table IV that the survival rate is independent of the pathological grade of the disease. However further to substantiate this opinion the pathological grades were subdivided into the clinical groups. These results were similar to those in Table IV in that no relationship is shown between pathological gradings and cure rate. We feel that these results tend to disprove Smith and Pollack's conclusions regarding the importance of pathological grading.

Several authors have attempted to show the relationship between end results and the site of the original lesion such as labia majora labia minora, vestibule and clitoris. In our group of cases with a few exceptions, however the local disease was so extensive that we were unable to determine accurately the site of origin and therefore were unable to classify the disease according to this method.

#### CLASSIFICATION

Numerous methods of classifying the clinical extent of carcinoma of the vulva have been used and these classifications are so different as to render impossible a comparison of end results from the different types of treatment. This may well be illustrated by the following classifications taken from the literature with a discussion as to the types of treatment and end results.

1. Bervin classifies carcinoma of the vulva by groups I II III and IV which have to do with the primary lesion only and stages I II and III which have reference to the regional lymphatics. His final classification includes

TABLE IV—GRADING AND END RESULTS

	Grade I	Grade II	Grade III
Total	80	46	
Alive no evidence of disease 5 years	3	3	5
Percentage survival	3.8	23.3	3.8

groups plus stages thereby giving 12 distinct clinical classifications as follows

Group I Tumors limited to one part of the vulva (1 cm diameter) without surface ulceration or deep fixation

Group II Tumors limited to one part of the vulva with ulceration and secondary infection with or without inflammatory inguinal nodes

Group III Local tumor extending beyond the part of the vulva primarily involved and possibly beyond the vulva itself

Group IV Tumors extending beyond the vulva proper to involve the vagina, the perineum or the skin of the surrounding parts by continuity or both the perineum and the skin of surrounding parts

Stage I Small well circumscribed movable nodes quite soft and obviously inflammatory

Stage II Enlarged indurated nodes thought to be metastatic.

Stage III Enlarged primary fixed nodes undoubtedly metastatic

Bervin treats these patients according to the stage, or the condition of the nodes. A primary lesion is always treated by electro-coagulation. All stages receive teluradium therapy to the groins. Patient with a stage I tumor is operated upon only if subsequent nodes appear. Stage II patients are subsequently operated upon (en bloc, superficial dissection only) if nodes do not completely regress following irradiation. Stage III patients receive no surgery to the metastatic nodes.

2. Smith and Pollack, Memorial Hospital classify the tumors as follows

Class I Tumors which show no extension (a) beyond the primary site on clinical examination, and (b) in which the regional nodes are dissected and no metastases are found on microscopic examination

Class II Tumors with inguinal nodes involved but operable as determined (a) by clinical examination and (b) by dissection of the nodes and positive biopsy findings

Class III Inoperable tumors with inguinal nodes fixed, swollen leg

Smith and Pollack's patients were treated with a variety of methods of surgery and of radiation, or a combination of the two

3. Taussig classified the tumors as follows

Class I Primary tumor less than 3 centimeters in size without nodes.

Class II Primary tumor 3 to 7 centimeters in size without nodes

TABLE V — COMPARATIVE END RESULTS

	Tausig	Bervin	Memorial Hosp.	R.P.M.I.
Total number cases	108	144	146	170
Number free of disease—5 years	32	65	35	45
Survival—5 years free of disease—%	30	45.0	23.9	25.5

Class III Primary tumor more than 7 centimeters in size with or without movable nodes

Class IV Primary tumor extending to vagina, suprapubic area with or without fixed nodes.

Class V Primary tumor far advanced, with ulcerative nodes and cachexia.

In Taussig's 108 cases complete vulvectomy with radical node dissection (Bast) was done in 41 patients, vulvectomy with superficial or incomplete gland removal was done in 21 additional cases and vulvectomy only or radiation or symptomatic treatment for palliation was used in the remaining cases.

Table V is a composite end result table of large groups of cases from various clinics classified according to the outlines given and treated by the methods described, and showing that regardless of classifications and of treatment used, the absolute cure rates are almost identical.

The classification used at R.P.M.I. Memorial Hospital has been modified and is repeated for the sake of comparison to explain Group III

Group I includes all primary cases in which the disease is still confined to the vulva regardless of the size

Group II includes all cases in which there is clinical evidence of metastasis to the inguinal nodes, superficial or deep

Group III includes all cases in which the disease has been treated (secondary) and the disease is still confined to the vulva. In these cases static nodes have developed but the disease is so classified because it is not clinically apparent. In some cases should be clinically apparent to the findings at the time of examination and since, in some cases, it is unable to ascertain the extent of the disease at the time of the examination, it is classified as such. In some cases elsewhere before treatment, it is unable to classify them as such.

It will be noted from the four methods of classification outlined that in two of the clinics great emphasis is placed on the extent of the primary neoplasm while in the other two clinics no consideration is given to the extent or size of the primary lesions. Also in none of the four clinics is the site of origin of the disease considered in arriving at a clinical classification although some of the clinics show very definitely that the site of primary involvement does influence the prognosis.

We do not think the classification we are using is adequate however we do not think that any of the other classifications as outlined is satisfactory. We therefore recommend that a classification employing all factors which have a bearing on the prognosis be devised and be accepted by all clinics in order that a more satisfactory evaluation of the various types of treatment may be obtained.

#### CONCLUSIONS

1. Three hundred and thirteen cases of carcinoma of the vulva are evaluated for statistical purposes.

2. Treatment and end results of these cases are given.

3. This series of cases is compared with three other groups of cases of an approximate number as to the absolute cure rate.

4. We conclude that thus far no marked advantage has been proved for the more radical type of surgery (Basset) if the absolute cure rate is considered.

5. We are of the opinion that there is no adequate clinical classification that uses all factors influencing end results and no clinical classification that is generally accepted. Therefore we propose that a committee should be appointed from some National Gynecological or Cancer Society to formulate an adequate classification.

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# URETEROSIGMOID ANASTOMOSIS

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THE voluminous literature on uretero-intestinal anastomosis and the multiplicity of methods for its accomplishment testify to the fact that to date no wholly satisfactory method has been found. In 1936 Hinman and Weyrauch's excellent presentation summarized all methods and fundamental principles to that time. This work was further supplemented by Hinman in 1939. Analysis of the literature subsequent to that time fails to reveal any further fundamental changes in the procedure. The method herein given has proved so successful in a small series that it is deemed worthy of presentation. It differs fundamentally from the usual methods in the following three principal points: (1) bringing the bowel to the ureter rather than the ureter to the bowel; (2) transplanting mucosa to mucosa; (3) eliminating the submucous tunnel.

## BRINGING THE BOWEL TO THE URETER RATHER THAN THE URETER TO THE BOWEL

The maintenance of proper ureteral peristalsis is vitally important in any uretero-intestinal anastomosis, and it is my belief that this factor coupled with an absence of obstruction at the site of anastomosis is of paramount importance in prevention of the upper urinary tract infection which occurs so frequently following this operation. There is considerable divergence of opinion as to whether stripping the ureter causes any interference with its normal peristaltic activity. However, it would seem that avoidance of destruction of extrinsic nerve and blood supply would be of undoubted value in the maintenance of proper physiological function of the ureter postoperatively. This fact was pointed out by Wharton in 1942. As will be demonstrated later in this discussion, at the completion of the operation the ureter is practically in its original bed and no

more than 1 to 1½ centimeters of denuded ureter lie above the site of anastomosis. The rest of the ureter remains within its normal bed. Most other methods free considerably more ureter than this, and it is my belief that this fundamental difference is an important one.

## TRANSPLANTING MUCOSA TO MUCOSA

Fundamentally this method was described by Chaput in 1896 who performed it experimentally on a dog and promptly abandoned it as being impractical. It is a fundamental principle in intestinal surgery that to avoid postoperative scarring and stenosis a mucosa-to-mucosa anastomosis is of vital importance. Hinman and Weyrauch offer the objection to this method that accurate approximation of mucosa to mucosa is difficult and cannot be done without gross contamination. In addition they believe that postoperative edema results in a more or less temporary interruption of the urinary stream. They also point out that the danger of peritonitis from postoperative leakage is very great. In our experience none of these difficulties have been encountered. We believe that an accurate approximation of mucosa to mucosa can be obtained with ease. There has been no interruption of urinary flow. In fact only 1 patient has failed to excrete at least 1,000 cubic centimeters of urine in the first 24 hours after operation and the output in some has been as high as 1,500 to 2,000 cubic centimeters. In addition the entire operative site is extra-peritonealized so that the danger of peritonitis is eliminated. It is felt that perhaps the objections offered by them were presented prior to the advent of proper bowel preparation with sulfathalidine or sulfasuxidine and that with the present methods of preparation these dangers no longer exist.

## ELIMINATING SUBMUCOUS TUNNEL

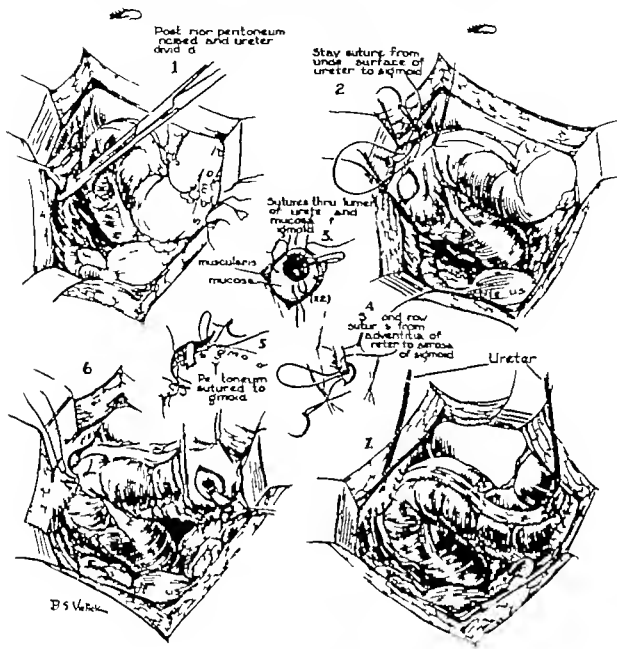
Production of the so-called submucous tunnel even when carefully prepared, is apt to

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Presented in the Forum on Fundamental Surgical Problems before the Clinical Congress of the American College of Surgeons, Los Angeles, October 18-19, 1948.







Fig

anastomosis. Minimal disturbance of the ureter can be accomplished by bringing the bowel over to the ureter for this suture (Fig 1 3). A stab incision is made through the submucosa and mucosa of the bowel. The opening should be just slightly larger than the circumference of the ureter. Care should be taken that this opening be neither too large as it is apt to leak or too small as stenosis might result. Sutures are then placed as shown in Figure 1 3. The first stitch is taken on the same side of the ureter as the previously shown anchoring stitch and is made by going through the wall of the ureter into the lumen through the

lumen of the bowel and out prior to being tied.

This procedure is then carried out around the entire circumference of the ureter producing a water tight junction. Care must be taken that these stitches be placed accurately to avoid any puckering of the anastomosis. In a normal ureter four sutures are usually sufficient to accomplish this purpose. However when a hydronephrosis is present any number of sutures may be used to obtain a water tight junction. No 0000 chromic catgut on an atraumatic needle is used (Fig 1 4). A second row of sutures is then placed between the serosa of the



Fig. 2a

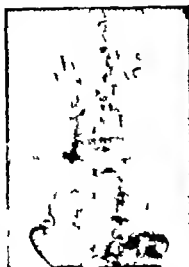


Fig. 2b



Fig. 3



Fig. 4



Fig. 5



Fig. 6

Fig. 2. Case 1. a, Fifteen minute intravenous pyelogram, 1 day postoperative shows excellent result on the left and grade I hydronephrosis on the right. b, 5 minute intravenous pyelogram, 5 months postoperative, shows less hydronephrosis on the right, good result on the left. This patient has shown excellent progress clinically.

Fig. 3. Case 2. Fifteen minute intravenous pyelogram, 15 days postoperative shows excellent function bilaterally with moderate right hydronephrosis. Patient complained of slight pain in the right side which had disappeared at time of discharge from the hospital.

Fig. 4. Case 3. Palliative operation for advanced carcinoma

of the uterus with endocervical fistula. At operation both ureter and bowel showed marked postirradiation fibrosis. Postoperative course completely satisfactory. Non-protein nitrogen normal, no signs of sepsis. Intravenous pyelogram made 15 days after operation.

Fig. 5. Case 4. Five minute intravenous pyelogram, 5 months postoperative, shows both ureters with minimal dilatation. No unusual hydronephrosis on either side. This patient had rather marked hypertension and function as not too good preoperatively.

Fig. 6. Case 5. Fifteen minute intravenous pyelogram taken 15 days after operation. Excellent clinical result.

bowel and the adventitia of the ureter. If the incision in the bowel wall has been too long each end may be closed separately from the serosa to adventitia sutures which were previously placed.

The second row of sutures serves a double purpose. It slightly invaginates the stoma into the lumen of the bowel producing a papilla, and also supplements the first row in producing a water tight junction thereby preventing



Fig 7



Fig 8



Fig 9

Fig 7 Case 6 Five minute intravenous pyelogram taken 10 days after operation. Uncomplicated convalescence.

Fig 8 Case 7 Ten day postoperative intravenous pyelogram. Excellent clinical result on the left. Non-functioning right kidney was present preoperatively but

ureter was transplanted anyhow with the hope that there would be some return of function.

Fig 9. Case 8 Bilateral grade II hydronephrosis. Poor case risk in series. It is hoped there will be some improvement. Patient had one attack of pyelonephritis, easily controlled. Intravenous pyelogram 10 days after operation.

postoperative leakage. Care must be taken in placing these sutures that too much ureter is not forced into the lumen of the bowel, thereby producing constriction. Figure 15 demonstrates closure of the posterior peritoneum with the bowel being brought over as shown in the illustration. The placing of these sutures is particularly important because it produces fixation of the site of anastomosis. They must be placed so that there is no angulation of the ureter and that it lies practically in its normal preoperative position. The sigmoid should be pulled downward slightly without producing too much traction on the anastomosis so that the ureter is maintained in a straight position. The completed closure is shown in Figure 16 which also demonstrates that the entire site of anastomosis is extraperitoneal at the conclusion of the operation. Figure 16 also shows the method used on the left side. The ureter is not brought through the mesentery but is brought out directly below the transverse portion of the sigmoid as shown in the illustration. Anastomosis on this side is really easier than on the right side. It is necessary that a taenia be used as the site of anastomosis. As a matter of fact, I believe the best results have been obtained

when the anastomosis was placed outside the taenia.

The same procedure is carried out on the left side as described on the right. Then the sigmoid is rolled downward to produce a straightening of the ureter and close the posterior parietal peritoneum. The end result is shown in Figure 17.

#### POSTOPERATIVE RESULTS

Up to the present time this procedure has been done in 26 consecutive cases with no mortality. Immediate postoperative complications have been almost completely absent. Three of the patients have had one attack of pyelonephritis after departure from the hospital. These have been very mild in character and all were easily controlled by sulfonamides. We have made no effort to avoid operating on patients who were poor risks. One of the patients had a rather marked hypertension with a very malignant early carcinoma of the bladder. Another had severe diabetes. Two others had had extensive deep radiation therapy with marked scarring of both ureter and bowel. These cases were certainly far from ideal but I believe presented a true test of the procedure. If it was successful in this type of patient



Fig. 2a.



Fig. 2b.



Fig. 3.



Fig. 4.



Fig. 5.



Fig. 6.

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The same procedure is carried out on the left side as described on the right. Then the sigmoid is rolled downward to produce a straightening of the ureter and close the posterior parietal peritoneum. The end result is shown in Figure 17.

#### POSTOPERATIVE RESULTS

Up to the present time, this procedure has been done in 26 consecutive cases with no mortality. Immediate postoperative complications have been almost completely absent. Three of the patients have had one attack of pyelonephritis after departure from the hospital. These have been very mild in character and all were easily controlled by sulfonamides. We have made no effort to avoid operating on patients who were poor risks. One of the patients had a rather marked hypertension with a very malignant early carcinoma of the bladder. Another had severe diabetes. Two others had had extensive deep radiation therapy with marked scarring of both ureter and bowel. These cases were certainly far from ideal but I believe presented a true test of the procedure. If it was successful in this type of patient

it should prove so under almost any circumstances. Both of these patients were operated upon for palliative reasons. It is too early to evaluate the end results of either the cancer surgery or the transplants. However we believe that the end results will prove satisfactory. Pyelograms of the first 8 patients are shown.

#### SUMMARY

1. A method for ureterointestinal anastomosis is presented.

2. Three fundamental principles are emphasized (a) minimal disturbance of the ureter from its bed the bowel being brought to the ureter rather than the ureter to the bowel (b) mucosa to-mucosa transplantation is accomplished (c) the submucous tunnel is eliminated.

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## PARTIAL GASTRECTOMY IN THE WAR YEARS

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THE surgical treatment of gastric and duodenal ulcers became a new problem in the war years (1940-1945). During the first year of the German occupation of Holland rations dropped fairly rapidly to about 1600 calories daily. The composition of the food varied considerably; it became poor in proteins and fat, rich in carbohydrates, and showed a great increase in cellulose content.

The quantity of rationed food remained practically constant during the first few years. The year 1944 brought an appreciable decrease. Serious famine swept western Holland in the winter of 1944-1945; rations dropped to 700 calories a day in November 1944, to 430 calories a day in February 1945 and finally to 200 calories a day in April, 1945.

In the beginning stomach patients were allowed extra rations, but even then the quantity of food was insufficient, especially in the large cities. Most people could not afford to buy appreciable quantities of food on the black market, so they were compelled to augment their rations with sugar beets and often even with ground tulip bulbs. The composition of the bread moreover was so bad (it consisted mainly of bean meal, pea flour or bulb flour) that it was quite unsuitable for patients with gastric ulcers.

As a result of these difficulties patients insisted on surgical treatment. They more or less had the feeling that without operation their chances of survival were small since the gastric ulcer made it impossible for them to eat a number of foods as such food would aggravate the ulcer. The surgeon on the other hand was of the opinion that the chances of obtaining a favorable result after gastric operation were poor: first because it was not possible to provide a reasonably suitable diet for an extended period of time after operation and second because the hospitals were greatly overcrowded and it was impossible to keep patients for more than a few weeks after operation. Operation involved an added risk for

the reason that the coal shortage was becoming so acute that beating of the operating theater had become practically impossible.

Despite all this a large number of operations were performed. The figure was higher than usual because in Holland too the number of gastric and duodenal ulcers was considerably on the increase. This increase started in 1934 and during the war the number of ulcer patients admitted to the hospitals became even greater. Relatively more large callous ulcers were noted. True, we did not see the *ulcère géant* as big as the palm of the hand as described by Moutier and Gutman or such as was encountered by De Langen (1947) and Jordan (1946), but we did observe a remarkably large number of big ulcers among them being one of  $1\frac{1}{2}$  inches and one of 2 inches in diameter. To our amazement and reassurance the direct results of operation were so much better than anticipated that we were encouraged to recall our patients for check up after a few years in order to judge their progress.

We have consistently reserved our decision to operate until at least one attempt to cure the ulcer by conservative measures has been made and has not been successful. We did not depart from this rule during the war. During this period we considered an obvious case of retention more an indication to operate than previously. Consequently we operated immediately in the presence of serious gastric hemorrhage when the gastric or duodenal ulcer had been located by means of the x-ray and the hemorrhage had recurred.

The considerable amount of blood necessary for transfusion in such operations constituted a great though not insurmountable difficulty. It was surprising even in the worst period of starvation that we could secure sufficient donors.

Our war time experience may contribute much toward improving our views regarding the origin of gastric and duodenal ulcers.

For example Professor Deelman of Amsterdam has repeatedly published reports of his



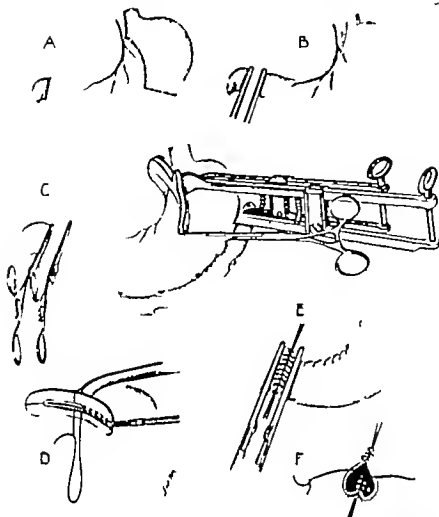


Fig. Schoemaker modification of Billroth I. A, Diagrammatic survey. The lesser curvature is for the greater part removed. The branch of the vagus nerve which runs downward alongside the lesser curvature is severed fairly high up. B, On the freeing of the greater curvature the duodenum is severed. C, The large clamp is placed fairly high up on the stomach. The stomach is severed along this clamp and along stomach-clamp. The large half of the clamp is removed and D the edge thus freed is sutured. After making second suture the new lesser curvature is made. Of the end-to-end connection between the remaining stomach opening and the duodenum the rear wall is sutured first. E, The serosa suture to the rear. F Mucosa suture. This is followed by a serosa suture to the front (not shown.)

investigations on the subject of the formation of duodenal ulcers. He confined himself to ulcers of the duodenum because it appeared to him that the process here is subject to more rapid changes in either direction both as to aggravation of the condition and as to the healing of the ulcer. It became clear that the mucous folds never alter their position and that the deepest folds generally lie at the front

and back. Under the influence of spasms, atrophy of Brunner's glands takes place, chiefly at the base of the deepest folds with epithelial spreads into the muscularis in the form known to us as the U D. Thus a primary role is attributed to spasms.

Van Eck (1947) arrived at the same conclusion from an entirely different angle. He determined the secretion of gastric juices not

at night, as Sandweiss (1946) did, but throughout the day by a standard diet spread over 3 meals, plus 1 glass of milk. This regimen produced peculiar results with certain constant characteristics for the various stomach disorders. It appeared that, despite the fact that in ulcer patients whose stomachs had previously shown by x ray examination that a barium meal passed normally, a large quantity of gastric juice nevertheless remained behind after a meal. This fact too points unmistakably to a derangement of the normal reflex mechanism of gastric evacuation caused by spasms (see Fredenhagen 1947).

The important part played by spasm in the formation of ulcers has now also been confirmed by war time experience as has been pointed out by Professor Boerema (1947) of Amsterdam.

The occurrence of intensified peristalsis and intestinal spasm became so frequent during the occupation that in the last years almost everybody suffered for longer or shorter periods from diarrhea and increased flatulence. Not only the altered composition of the food but also psychic strain must have caused this. Affections which are allied to spasms, such as ileus of the small intestine and fissure prolapse of the anus and rectum were much more frequently encountered during the war than in peacetime (Boerema, 1947).

The great increase in the number of ulcer sufferers during the war must undoubtedly be closely connected with the strong inclination to spasm. These spasms were so often observed during x ray examination that many ulcers were mistaken for carcinoma. Of the 129 ulcers operated upon by us during the last year of the war, 6 showed the characteristics of carcinoma but upon microscopic examination of the prepared specimens were found to be benign ulcers.

That an increased hydrochloric acid content of the gastric juices should exert a primary influence is not very likely, because during the hunger period an achylia gastrica was very often met with (see Palmer and Nutter 1940). The opinion at present again being voiced that psychic strain is a factor giving rise to gastric and duodenal ulcers is confirmed by our experience. It was not so much fear of the

often inhuman measures taken by the Germans as the daily recurring vexation at their behavior. This can be judged only if one has experienced it himself.

#### TREATMENT

In treating most of the patients we used the Schoemaker modification of the Billroth I resection. The elder Schoemaker described this method in *ELDERGY GYNECOLOGY AND OBSTETRICS* in 1921.

After the greater and lesser curvatures have been loosened and the duodenum is freed to a point beyond the ulcer, the duodenum is severed between clamps. A large double clamp is placed high up on the stomach and obliquely to this a stomach clamp. After removal of the part of the stomach to be resected, half of the large clamp is taken off to allow the mucous suture to be made and on removal of the other half the new lesser curvature is prepared with a Lembert suture. The two remaining stomach clamps are brought together and an end-to-end suture is made in two layers (Fig. 1). If the left gastric artery is ligatured high up in the lesser omentum the stomach may always be drawn down sufficiently to perform a large resection.

By placing the stomach clamp high up in this manner all the branches of the vagus nerve that communicate the stimulus for increased peristalsis or spasms are in all probability severed. As described years ago (see among others Mueller 1924) stimulation of the vagus with a small dose of pilocarpine produces increased peristalsis, with a large dose spasms are induced. It is known that the vagus branches which run downward along the small curvature are the ones that control the movements of the stomach (see Fig. 1a).

As a rule a Billroth I was performed. Only when as a result of infiltration the duodenum could not be loosened beyond the ulcer was resection for exclusion according to Finsterer (1918, 1933) that is, a modification of Billroth II performed. We are of the opinion that when an adequate portion of the duodenum can be freed beyond the ulcer to close it for a Billroth II, one might just as well establish a connection according to the Billroth I operation. Only when a large area of inflammatory

infiltration was noted around the duodenum and when the patient was in bad general condition was a posterior retrocolic gastroenterostomy done as an exception. If the stoma is properly made satisfactory results should follow (Gray and Sbarpe 1946).

When hemorrhage was profuse and recurrent resection was always carried out without a search being made for the bleeding blood vessel. In such cases liberal transfusions of blood were given.

The total number of patients operated upon during the last 3 war years was 129. Of these 40 had ulcer of the stomach and 89 had ulcer of the duodenum a proportion of 1 to 2.2.

Of the patients with gastric ulcers 36 were men and 4 were women (9 to 1) and of the patients with duodenal ulcers, 81 were men and 8 were women (10 to 1) (see Gainsborough and Slater 1946). The total mortality was 4 (3.1%). Of these 4 cases we note the following.

A Billroth I was done in a 44 year old patient with a gastric ulcer patient died of pulmonary embolism.

Two patients with extensive inflammatory tumors of the duodenum were subjected to resections for exclusion according to the method of Finsterer. Both patients were in such poor general condition that they could no longer overcome the peritonitis which developed as a result of the inadequate duodenal stump.

The fourth patient underwent a serious operation to relieve an extensive hemorrhage associated with an ulcer which had penetrated deeply at the back of the duodenum. During the Billroth I resection the ductus choledochus had to be ligated before the ulcer was removed. A cholecystoduodenostomy was made. Despite the use of liberal blood transfusions the patient died of postoperative shock.

Of the 129 patients operated upon 111 had Billroth I resections, 4 patients had gastroenterostomies and a cutout resection was performed in 14 patients.

#### RESULTS

Follow up examinations were possible early in 1948 in 105 patients. It appeared that not

a single patient had died of starvation. All but 10 patients had been able to tolerate the poorly digestible food during the famine. Of the 94 patients who had had a Billroth I resection 86 showed what might justly be termed 'very good' results for they were no longer on diet the stomach could stand peas, beans, cabbage and the like. A normal meal could be taken by all. However some complained that exceedingly large quantities gave them a heavy feeling in the stomach. They were all carrying on their normal pursuits. Their general dietetic condition was normal and there was no anemia. In 6 patients (6.4%) the result could be considered to be satisfactory but there were a few complaints. In 2 of them large quantities of food at a time could not be taken so that they had to have a fourth meal in addition to the 3 main meals. One patient suffered from a scar hernia. Two patients still had stomach complaints. Two patients did not really complain about their stomachs but were psychically so deranged that they could not pursue their normal activities.

Röntgenograms failed to show any sign of a recurrent ulcer in any of these 6 patients. Complaints from 2 patients (2.1%) were such that a second operation became necessary.

One of them was operated upon anew in another hospital where a secondary stomach resection was performed according to the Reichel Polya technique for treatment of ulcer deep down in the duodenum. (In addition, a mock operation was performed on this patient who played an important part in the underground movement in order that he might be kept out of the hands of the occupying power.)

It will be noted from our study that heavy psychic burdens are an important factor in cases of recurrence.

The second patient with serious complaints was, in the opinion of the x ray specialist, suffering from a new ulcer which had formed near the new stomach outlet. The operation carried out elsewhere revealed no ulcer. The stomach passage seemed to be obstructed, as a result of growing out of shape of the ligamentum teres hepatis as a broad strip over the anastomosis. Most of this ligament was

removed and the patient made no further complaint.

Of the 4 patients who had gastroenterostomies made because of their poor general condition 2 could be traced. Neither of them had had any complaint after the operation. One of them committed suicide 4 years after operation, a fact which again serves to confirm our opinion that many ulcer patients are psychically unbalanced.

It was possible to re-examine 7 of the 14 patients who had had cutout resections. Six of them had no complaints. One of them complained 1 year after operation of pain when his stomach was empty. On re-examination (3½ years after operation) an ulcer was indicated on the anastomosis for which the patient is now undergoing dietetic treatment.

To sum up of the total number of patients re-examined (105) only 2 recurrences were established (1.9%). Our results are no less favorable than those obtained by Schoemaker Sr. in the years 1923 to 1937 (Ten Kate 1940) and seem very satisfactory if we compare them with those of others. Still 1936 Lake 1937 Lahey and Marshall 1937 Graham, 1938 Steinberg 1940, and Walters and Claggett 1940.

#### THE DUMPING SYNDROME

Finally we would record a few remarks on the so-called 'dumping syndrome' (See Berkman and Heck, 1945; Zollinger and Hoerr 1947). The syndrome did not occur among our patients. This is to be expected if one bears in mind that with a Billroth I operation the evacuation of the stomach is only slightly more rapid than in a normal stomach.

The complaints which were occasionally made on the tenth day after the operation on consumption of the first quantity of solid food were caused by the difficult passage of the food past the anastomosis. When the diet was slightly reduced the complaints vanished in all patients after a few days.

The occurrence of diarrhea as described in the dumping syndrome was such a general phenomenon in war time that no value could be attached to it. The only deviation among our patients which points in this direction was the following when they were asked emphati-

cally about it some patients stated that they were troubled by it when they rounded off a hearty meal with a dessert which was rich in carbohydrates, such as custard or sweet gruel. This was the case in 4 of the patients re-examined.

A few patients had occasional attacks of giddiness and have had to lie down. In my opinion this phenomenon indicates a rapid carbohydrate absorption and so is not the real dumping syndrome. For that matter not a single patient made these complaints when the excessive quantity of carbohydrates was omitted at the end of the meal.

The absence of the 'dumping syndrome' with the Schoemaker modification of the Billroth I operation was confirmed a short time ago in material published by the Mayo Clinic. According to Custer, Butt and Waugh (1946) the dumping syndrome occurs in its serious form in 28 of 500 resections based on the Reichel-Polya technique. This fact impelled the surgeon Waugh to use a different method of stomach resection. No permanent 'dumping syndrome' occurred among the 37 patients operated upon by him according to the Schoemaker modification of the Billroth I operation (see also Ogilvie 1947).

Our experience gives us confidence in our opinion that the latter operation gives the best results.

#### SUMMARY

A description is given of the difficulties which arose in the surgical treatment of gastric and duodenal ulcers in Holland during the war. Despite these difficult conditions the results on re-examination of the patients did not appear to be less favorable than those reported under normal circumstances: the total mortality was 3.1 per cent.

Of 102 patients re-examined 94 (90%) had no complaints. 8 had complaints which were due not to a recurrence. 2 patients had a recurrence of the ulcer and 1 patient had a stomach complaint caused by adhesions.

The favorable results among which were the absence of the dumping syndrome are a reason for us to apply the Schoemaker modification of the Billroth I technique for stomach resection whenever possible.

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# A DOUBLE JEJUNAL LUMEN GASTROJEJUNAL ANASTOMOSIS

## Pantaloons Anastomosis

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IN 1933 and again in 1934 I published studies on the role of spasm in the etiology of peptic ulcer. In one of these studies a larger jejunal lumen was created by anastomosis of two parallel jejunal segments in an antiperistaltic direction. This enlarged jejunal lumen was anastomosed to the proximal part of the stomach. The distal gastric segment was closed according to the method of Devine and Von Eiselsberg and at the same time alkaline duodenal contents were diverted from the gastrojejunal anastomosis by the Y anastomosis of Roux. The enlarged jejunal lumen created by this procedure counteracted any obstruction produced by spasm of the jejunum at the site of anastomosis. None of 4 dogs developed jejunal ulcers during a period of 72 to 225 days after creation of the double lumen jejunal anastomosis. However 9 out of 12 dogs developed jejunal ulcers when the usual single lumen jejunal loop was used in a similar manner. One of the latter animals was found to have a jejunal ulcer 3 centimeters in diameter with a deep crater. The single jejunal loop was reconstructed with formation of a double lumen anastomosis without disturbing the area of ulceration. One month after this reconstruction operation the deep crater of the ulcer was found to be partially healed. Not only did the 4 dogs with the double jejunal lumen anastomosis fail to develop ulcers they also gained weight and remained in good health.

In 1943, while performing a gastrectomy for duodenal ulcer I observed that the jejunum was unusually narrow with spastic walls. The narrow lumen of the jejunum and the spasticity of its musculature did not change during the gastrectomy. I was apprehensive that the anastomosis of the gastric remnant to a je-

junum with such an unusually narrow lumen would result in emptying difficulties and might predispose to the formation of a jejunal ulcer. Recalling my experiments reported in 1934 with the double barrel anastomosis which failed to result in jejunal ulcerations and which gave no emptying difficulties I established gastrojejunal continuity by the method mentioned. The patient made an uneventful recovery and has remained in good health since.

Varco, Code, Walpole and Wangensteen invariably produced peptic ulcers in normal dogs by daily injection of histamine in beeswax. Lannin made extensive experiments with the histamine in beeswax preparation to determine which of the various gastrojejunal anastomoses gave the most protection against jejunal ulcer. He was able to produce jejunal ulcerations in all dogs subjected to gastroenterostomy and to the Devine exclusion operation. In our experiments we have performed gastroenterostomy and the Devine exclusion operation but in place of the standard single lumen jejunal anastomosis we have employed the double lumen jejunal anastomosis. Two normal dogs were given daily injections of histamine in beeswax. Both of these animals developed duodenal ulceration. Of 3 dogs with the double barrel jejunal anastomosis only 1 developed jejunal ulcerations. The 2 other dogs remained in perfect condition. There was no evidence of erosions or ulceration in the upper intestinal tract of either dog after daily injections for 43 days.

The experiments with the histamine beeswax injection and with the Roux short circuiting procedure showed that animals with the double barrel anastomosis were less prone to develop postoperative jejunal ulcer than animals with the usual single loop anastomosis. Other possible advantages of the double lumen

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ana tomosis encouraged us to apply this method in a few selected cases in which the patients were suffering from carcinoma and from peptic ulcer.

CASE 2. H-5433 C. S., male, aged 72 years was admitted on December 21, 1946. This patient was treated for emphysema elsewhere for 3 years. He complained of epigastric distress which had started about 5 years prior to admission. He had been unable to retain an food for 1 month and had lost 40 pounds in weight.

Examination revealed a confused, extremely emaciated and weak individual who was unable to walk without assistance. There was a movable tumor about 6 centimeters in diameter to the right of the midline in the upper abdomen. There was nutritional edema. At this patient was prepared for intra venous injection of amino acids, glucose, plasma and lamin preparation and abdominal exploration was performed.

At operation on December 10, 1946 there was a closed tumor at the lesser curvature of the stomach which had penetrated into the pancreas. There was evidence of metastases. The abdominal cavity contained approximately 500 cubic centimeters of yellow colored fluid. The tumor mass was more than 4.5 of the stomach was removed. Retrocolic ana tomosis between the small gastric remnant and jejunum was made by the double barrel method. After operation there was no bile in the gastric suction bottle at any time. Convalescence was uneventful. The patient has gained 55 pounds in weight and employed as a laborer. He tolerates his food and has no postprandial distress (Fig. 1).

CASE 3. H-00946 M. D., male, aged 56 years was admitted on March 11, 1947. He complained of epigastric distress and pain which had started about 3 months before admission to the hospital. There was a weight loss of 20 pounds. Roentgenographic findings were negative. Gastroscopic examination revealed a ulcerating tumor mass which was about 5 centimeters in diameter and was located on the anterior gastric wall proximal to the re-entrant angle surrounding the mass the gastric wall was rigid and inflamed.

At operation on March 13, 1947 a solid tumor mass was revealed about 5 centimeters in diameter on the anterior wall of the transverse stomach. The lesser omentum contained a solid oblong mass 5 centimeters long and 5 centimeters thick. There were no metastases to the liver or greater omentum. The mesentery of the jejunum was stuffed with enlarged firm lymph nodes. The gross appearance of the tumor was that of lymphosarcoma. The mesentery and more than 4.5 of the gastric tissue were removed. A small gastric pouch was anastomosed to the jejunum by the double barrel procedure. At the final examination confirmed the gross appearance of the tumor as that of lymphosarcoma.

The patient's course was uneventful. There was no bile stained drainage in the gastric suction bottle at any time after operation. He has had a satisfactory treatment since his discharge. There has been no weight gain. He is on a liberal diet but complains occasionally of nausea (Fig. 2).

CASE 4. H-01507 L. M., male (physician) aged 82 years was admitted on April 6, 1947. This patient complained of epigastric pain and dyspepsia of 5 months' duration. He forced himself to vomit in order to obtain relief. He had lost about 10 pounds in weight. At the age of 30 similar attacks of severe gastric pain and distress had been experienced.

Roentgenographic examination revealed a constant firmity in the distal half of the stomach with 5 hour retention of most of the barium.

At operation on April 10, 1947 more than 3/4 of the gastric tissue was removed including a tumor mass about 4 centimeters in diameter situated on the posterior wall of the stomach about 3 centimeters proximal to the pylorus. The stomach walls were thick and edematous. Antecolic gastrojejunostomy was made with a long double barrel jejunojejunostomy pouch.

He had partial gastric retention for 4 or 5 days after the gastrectomy but in spite of the retention gastric contents were not bile stained. Since discharge he has gained more than 20 pounds in weight. He follows no dietary restrictions and has no postprandial complaints (Fig. 3).

CASE 5. H-01343 O. R., female, aged 51 years was admitted on April 2, 1947. This patient was admitted complaining of pain and epigastric distress and vomiting of 5 or 6 years duration. Roentgenographic examination revealed retention of 3/4 of the barium after 5 hours with absence of peristalsis was evident. Malignancy could not be ruled out as the cause of the pyloric obstruction.

At operation on April 7, 1947 there was a closed a scarred and deformed duodenal cap with ulceration. About one half of the gastric tissue was removed. Retrocolic gastrojejunostomy was performed by the double barrel method. After operation the gastric contents in the drainage bottle were not bile stained at any time. At the present time the patient is symptom free and has gained 30 pounds in weight (Fig. 4).

CASE 6. H-01102 S. B., male, aged 63 years was admitted on March 26, 1947. He was first seen in August 1945 at which time he gave a history of distress, gastric pain in the upper abdomen and some difficulty in swallowing. He had a frequent urge to move his bowels. A diagnosis of carcinoma and carcinoma of the rectum was made. The esophagus was dilated by bougienage. Abdominal peritoneal resection in one stage was performed November 30, 1945.

At operation on April 2, 1947 an ulcer was found on the posterior wall of the stomach near the cardia. There was edema and induration of the anterior and posterior wall of the stomach. About 3/6 of the

gastric tissue was removed. The lesser curvature of the stomach near the cardia was inadvertently opened and after it was repaired the remaining gastric pouch was narrowed. The terminal gastric stoma was enlarged along the greater curvature side. A retrocolic gastrojejunal anastomosis was made by the double barrel procedure. There were no bile stained secretions in the gastric suction bottle. He made an uneventful recovery and has gained about 12 pounds in weight. Although he has no difficulty eating, a roentgenographic examination reveals a dilated esophagus with delayed entry of barium at the cardia (Fig 5).

#### THE BRAUN ENTEROENTEROANASTOMOSIS AND THE DOUBLE BARREL GASTROENTEROANASTOMOSIS

Braun introduced the enteroenteroanastomosis in 1892 as a supplementary procedure to gastroenterostomy and to Billroth II gastrectomy. The Braun enteroenteroanastomosis gained rapid popularity because of its promise to forestall gastric retention.

In the presence of a clear passage either at the proximal or distal extremity of the gastroenterostomy a functioning enteroenteroanastomosis could be relied upon to prevent gastric stasis. With complete blockage at both extremities of the gastric stoma a functioning enteroenteroanastomosis would provide no relief for gastric retention. The Braun procedure proved less successful when performed in the postoperative period for the relief of a well established gastric stasis. Nevertheless it is not without merit as a prophylactic and supplementary procedure in operation for gastric malignancy. However the double barrel anastomosis functions as an enteroenteroanastomosis and in addition provides more assurance for a free passage for the gastric contents than does the standard single lumen anastomosis. The double barrel procedure embodies the enteroenteroanastomosis of Braun and a gastroenteroenteroanastomosis in a single anastomotic maneuver without a break in continuity.

Gastric evacuation in the early postoperative period following the Billroth II gastrectomy is accomplished largely by hydrostatic pressure. The anatomical relationships between the gastric pouch and the jejunum are under the control of the operating surgeon. These relationships determine the mode of

evacuation of the gastric contents. Except for the transitory stasis in the proximal duodenal loop and in the gastric pouch serious retention is nearly always due to improper and careless technique. Only in a case of reoperation are there occasionally presented reconstructive problems with technical difficulties not under the complete control of the operating surgeon. In my early experience with the gastrectomy operation exploration was carried out in 2 patients because of gastric ileus. There is reason to believe that these 2 patients would have recovered without additional surgery as did 2 other patients who developed gastric retention. In my last 350 consecutive gastrectomies for ulcer or carcinoma reoperation because of gastric retention was not necessary in any case.

Even under the most favorable conditions it is more difficult to assure the emptying of the gastric contents following a gastroenterostomy than after a Billroth II type of gastrectomy. In the presence of the pylorus and the muscular transverse stomach (antrum) the anatomical relationships after gastroenterostomy cannot always assure the emptying of gastric contents through the gastroenterostomy stoma by simple hydrostatic pressure. When gastroenterostomy is performed in the presence of a dilated atonic stomach evacuation is impaired to a greater degree. Under these conditions a double barrel gastrojejunostomy with a large stoma should have a much better chance of assuring the emptying of the gastric contents than the standard type gastroenterostomy (Fig 6). The performance of the double barrel anastomosis require more time than performance of the standard single loop gastrojejunal anastomosis. Edema and infection because of a faulty suture technique, torsion of the anastomosis or a thick mesocolon attached in the immediate vicinity of the anastomosis will prove equally disastrous for any type of gastroenterostomy or gastrectomy. A malfunctioning stoma is largely the result of either insufficient experience or the lack of supreme diligence.

Transitory stagnation from postoperative inertia takes place after any type of gastric operation. Inertia and partial stagnation



should be prolonged after the double barrel anastomosis because the newly fashioned inert jejunal sacculatioo and the gastric remnant empty through hydrostatic pressure and gravity due to change in the patient's position. The important consideration however is the assurance of a wide and unobstructed passage which gives the double barrel anastomosis a long term advantage over the standard type anastomosis. Initial stagnation is effectively controlled by the Wangenstein method of continuous lavage.

No serious gastric retention resulted in the 25 patients operated upon by the double barrel jejunal lumen anastomosis. It was necessary to introduce a Levine tube twice in one patient on the fifth postoperative day. In another patient in whose case antecolic gastrectomy was performed the jejunojejunal anastomosis was unusually long. The patient complained of nausea and fullness for about 5 days following the operation. Gastric emptying was not complete and was relieved by periodic lavage. The patient began to take nourishment on the third postoperative day.

#### REFLUX OF GASTRIC CONTENTS INTO THE AFFERENT ENTERIC LOOP. REGURGITATION OF BILE AND PANCREATIC JUICE INTO THE STOMACH. VOMITING OF BILE. GASTRITIS. THE POST GASTRECTOMY SYNDROME.

Hofmeister's modification of the Reichel Polya gastrectomy consists of partial closure of the cut end of the stomach at the lesser curvature. This technique gives more security to the gastrojejunal anastomosis at this angle. Finsterer popularized the Hofmeister modification. He laid particular emphasis on the prevention of reflux of the gastric contents into the proximal jejunum and into the duodenum by cutting the stomach in a line parallel to the direction of the esophagus, and by the formation of a spur at the lesser curvature. Finsterer feared that reflux of gastric contents into the duodenum would jeopardize the duodenal closure. Finsterer when first introduced the exclusion resection for duodenal ulcer also reasoned that the back flow of the gastric contents into the pyloric remnant through the open pylorus presented a predisposing factor to jejunal ulceration. It is unlikely that back

flow of gastric contents into the afferent loop could be the cause of a blowout of the duodenal stump. Either a stenosis at the proximal angle of the anastomosis or most commonly the faulty technique of duodenal closure, is responsible for the leakage from the duodenal stump.

The reflux of gastric contents into the proximal jejunum and duodenum is desirable because of the enhanced production of secretin and the alkaline pancreatic juice which should prove to be an additional safeguard in the prevention of jejunal ulcers and also an aid in intestinal digestion. There seems to be no valid objection to the reflux of gastric contents into the proximal loop provided that these contents are prevented from regurgitating back into the gastric pouch. The degree of regurgitation of the intestinal contents back into the stomach depends on the technique of the gastrectomy operation. A. B. Watson recently reviewed the end results of 132 gastrectomies and reported 12 cases of patients who vomited bile. Two of my own patients have had antecolic gastrectomies performed elsewhere with a long afferent jejunal loop attached to the greater curvature angle. These patients have complained of frequent vomiting of bile. Some of the dyspeptic complaints after the Finsterer-Hofmeister operation result from an unpredictable variation in the technique which allows an excessive amount of bile and pancreatic juice to enter the gastric remnant. Alkaline duodenal contents regurgitating into an empty stomach may cause irritation and inflammation of the gastric mucosa. A few of my patients complain of a "bitter stomach" and anorexia at breakfast time. The extent of the regurgitation of the alkaline duodenal contents into the gastric remnant may conceivably be the answer to some of the disappointing results of the gastrectomy operation which some consider to be related to postoperative gastritis.

Cure of the original ulcer and prevention of jejunal ulcers are considered in part to depend on the regurgitation of bile and the alkaline pancreatic juice into the stomach. Boldyreff thought that regurgitation of bile and pancreatic juice into the stomach is a normal process which serves to regulate and maintain



Fig 1



Fig 2



Fig 3



Fig 4



Fig 5

Fig 1. Case 2. Roentgenogram taken 8 months after gastrectomy for carcinoma. The gastric remnant extends no more than about 3 centimeters beyond the cardia. The double barrel saccululation has enlarged since the operation.

Fig 2. Case 3. Roentgenogram taken 2 months after gastrectomy for lymphosarcoma. Only a small gastric remnant is left. The double barrel anastomosis is long and narrow.

Fig 3. Case 4. Roentgenogram taken about 1 year after antecolic gastrectomy for a carcinoma of the stomach. The

faint shadow between the gastric remnant and the large jejunal saccululation shows valve-like formation at the gastrojejunal stoma.

Fig 4. Case 5. Roentgenogram taken about 1 year after gastrectomy with double jejunal lumen anastomosis for duodenal ulcer with obstruction.

Fig 5. Case 6. Roentgenogram taken about 1 year after gastrectomy with double jejunal lumen anastomosis. Minimal gastric remnant with only a few flecks of barium shadow showing.

gastric acidity at a constant level. Authi Kesavalu and Frank Mann concluded that the presence of even the entire duodenal contents in the stomach does not cause effective neutralization, buffering and dilution of gastric acidity in either the fasting or the digesting state. It is questionable if the slight and

infrequent duodenal regurgitation that occurs normally can be a primary and essential factor in controlling intragastric acidity. (Authi Kesavalu and Frank Mann). Schmilinsky conceived the idea of the formation of an inside apothecary by anastomosis of the proximal jejunal loop into the stomach thus diverting



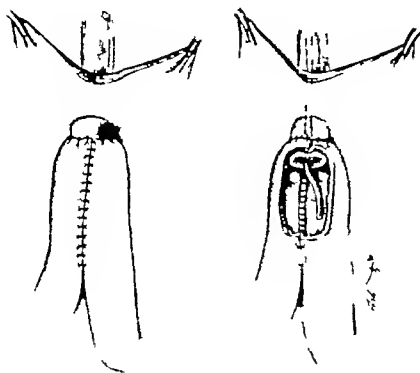


Fig 8. Total gastrectomy with a double barrel esophagojejunal anastomosis. a, left. The anastomosis completed. The anchoring sutures of the jejunum to the diaphragm are not shown in this illustration. b, Window in the anterior wall of the completed double barrel anastomosis to demonstrate valve-like formation.

predictable variation in technique permitting too much reflux of intestinal contents into the stomach. In a recent publication the writer has analyzed some of the technical variations of the Billroth II gastrectomy which are likely to result either in jejunal ulceration or in postoperative disabilities not related to jejunal ulcer. Attention was called to disabilities following the Schmilinsky operation gastrectomy with the proximal jejunal loop joined to the greater curvature angle of the anastomosis and also following creation of a long proximal jejunal loop placed either at the lesser or at the greater curvature angles of the gastrojejunal anastomosis. It was reasoned that such variations in the operative technique of the Billroth II operation permit regurgitation of the alkaline enteric contents into the gastric pouch causing nausea, anorexia and vomiting. The severity of the symptoms caused by reflux of intestinal contents will largely depend on the extent of regurgitation into the stomach. In the Hofmeister Finsterer operation a variable part of gastric wall along the lesser curvature is invaginated into

the gastric lumen. This tumor like formation receives the impact of the enteric contents from the proximal loop which in part may be propelled directly into the distal jejunal loop without entering the stomach. Closure of the gastric stoma along the lesser curvature angle also creates a smaller gastrojejunal opening than in the original Reichel Polya operation. The freedom from nausea, anorexia and vomiting in by far the greatest majority of my own gastrectomized patients is evidently the result of mechanical factors inherent in the technique of the gastrectomy operation. Though there have been several patients complaining of nausea and anorexia and also an occasional patient reporting one or two vomiting spells soon after leaving the hospital, I have no knowledge of any of my gastrectomized patients ever complaining of frequent vomiting.

The favorable results are at variance with the experience of others. Schindler's clinical and gastroscopic studies on the postoperative stomach are extremely discouraging. He reports a great number of patients who are not

relieved of pain by surgery and who do not return to the surgeon who performed the operation but consult others.

In some hospitals there are a really terrifying number of such patients observed who after gastric surgery had become permanently incapacitated (Schindler). The observation was made that their distress proved to be almost intractable. Schindler was the first to describe the frequency of severe gastritis in the postoperative stomach. He observed that when there were rhythmical pyloric like activities of the artificial stoma there was no evidence of gastritis. Schindler agrees with others that the gravity, the extent and the various forms of gastritis in the postoperative stomach impressively exceed all other pictures of inflammation (Gutzeit and Teitge).

From the grandiosity of these changes alone and without knowledge of the case history and of the clinical findings it is possible to recognize the postoperative stomach (Gutzeit and Teitge). Schindler concludes thus: "the unregulated reflux of intestinal juice through a patent stoma is the chief reason for the origin of the chronic inflammation of the postoperative stomach and that operations which do not prevent this reflux cannot be considered as proper treatment for an essentially benign disease such as peptic ulcer."

Again quoting from Schindler: "there is a saddening unanimity of opinion that treatment of the gastritis of the postoperative stomach is one of the most hopeless tasks. The symptoms of postoperative gastritis are characterized by torturing continuity and intractability."

Personal experience with the gastrectomy operation for peptic ulcers over a period of 24 years has been most gratifying. Only a few patients are annoyed and partially incapacitated. Postgastrectomy complaints and disabilities do not always follow a similar pattern. At times it is difficult to elicit any definite symptoms. The patient simply states that "all is not well." Weakness, fatigue, dizziness, and a fleeting feeling of faintness are frequent complaints. The inability to gain weight is resented by many patients. Some patients have ravenous appetites while others com-

plain of anorexia. There may be a bizarre tolerance to highly seasoned foods such as pickled herring, onions, etc., and an intolerance to milk and pastries. The postprandial feeling of fullness and rapid pulse and perspiration usually disappear after lying down. These symptoms are thought to be brought about by an overdistended gastric pouch or from the peripituitous emptying of the gastric contents into the jejunum, "dumping syndrome," also causing overdistention of the jejunum and initiating a splanchnic reflex. The relief brought about by a recumbent position is considered to be due to slowing of gastric evacuation. Absorption of sugar from the precipitous emptying of the gastric pouch is also considered to be related to symptoms characterized by dizziness, fleeting faintness and occasional syncope. Though I have seen many patients in my office with postgastrectomy complaints, none have had symptoms which were severe enough to require hospitalization. It is not improbable that some of these patients have sought relief for their complaints elsewhere.

The nature of some of these postgastrectomy symptoms is not well understood and it is inconceivable that all of them can be explained on the basis of gastritis due to reflux of enteric contents into the gastric pouch. While it is reasonably certain that a double barrel anastomosis will be effective in preventing the regurgitation of bile and pancreatic secretion into the stomach, it is too early to appraise this operation in relation to the postgastrectomy symptoms not related to the reflux of enteric contents into the stomach. One may be permitted a hopeful speculation that the double barrel jejunal saccululation may also act as a buffer causing a retardation of the jejunal evacuation.

#### THE TECHNIQUE OF THE DOUBLE BARREL OPERATION AND ITS SPECIAL INDICATIONS

The double barrel procedure can be applied to any variation of the Billroth II gastrectomy, total gastrectomy or gastroenterostomy. The completed anastomosis with the flaring of the afferent and efferent bowel loops from the crotch of the newly created saccululation resembles a pantaloons garment in its appearance.

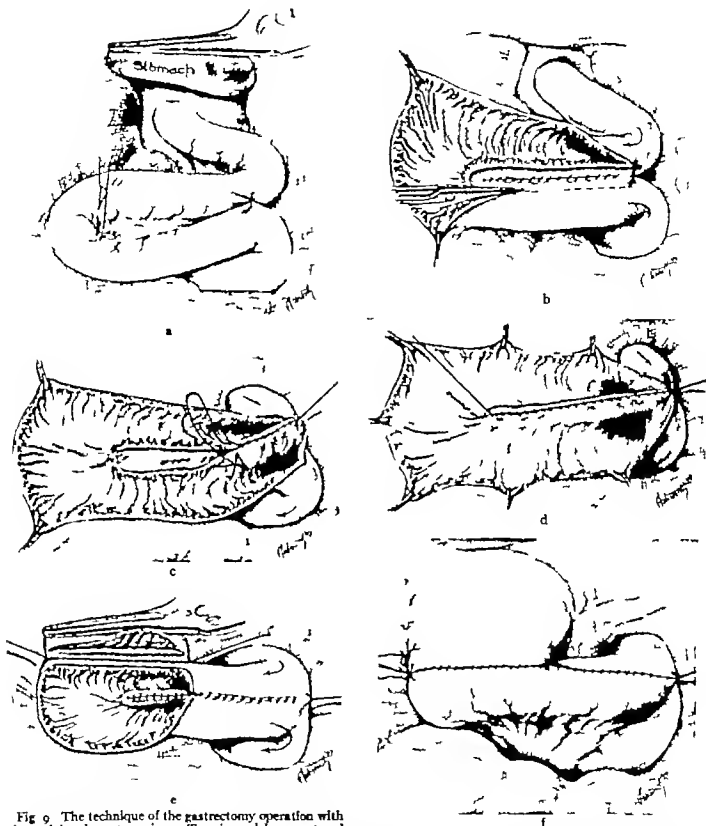


Fig. 9. The technique of the gastrectomy operation with a jejunojejunal anastomosis. a, Two jejunal loops sutured together. The proximal loop should be longer than is shown. b, The first seromuscular suture completed along posterior wall. An opening, not shown, is first made in jejunal wall at jejunal bend and close to mesentery. The jejunal loops are flared open. c, The beginning of second row of through and through continuous hemostatic suture for posterior wall. d, The hemostatic sutures for the posterior wall close to the mesentery completed. e, First continuous sero-

muscular suture completed to approximate the anterior jejunal walls. Interrupted silk sutures between posterior gastric wall and posterior wall of jejunal sacculculum. f, The double barrel jejunal anastomosis completed. The artist sketched this operation during a double barrel gastrectomy in which the whole gastric stoma was utilized for the gastrojejunal anastomosis. In most of these gastrectomies a part of the gastric stoma along the lesser curvature is closed.

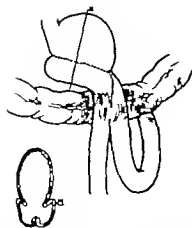


Fig. 6. Diagram of antecolic double barrel anastomosis.  
a, Cross section showing the valve like formation at the stoma.

In the first double barrel gastrectomy performed for a duodenal ulcer in 1943 the anterior suture line of the double lumen jejunal sacculation was anastomosed to the greater curvature angle of the gastric remnant. This technique was also used in experimental animals with good functional results. In 1 gastrectomy the anterior suture line of the jejunal sacculation joined at the center of the anterior wall of the gastric stoma.

The efferent and afferent loops of the jejunum are joined in an antiperistaltic direction by interrupted sutures close to the mesentery in order to prevent the protrusion of a large mucosal fold into the lumen at the jejunal bend. The jejunal walls flare wide apart at the jejunal bend permitting a wide approximation between the jejunum and stomach. The gastrojejunal stoma is made to protrude into the jejunal sac in a valve like fashion which aids in preventing regurgitation of intestinal contents into the stomach. After completion of the anastomosis both jejunal loops are approximated to each other by a few sutures distal to the crotch of the pantaloon seat in order to prevent possible intussusception of the proximal jejunal loop into the sacculation.

In the operation for jejunal ulcer the old jejunal stoma may be reconstructed to fit into a double barrel type of anastomosis (Fig. 7).

The double barrel type of anastomosis is particularly adaptable in gastrectomies for

ulcers near the cardia and for carcinoma when only a small fragment of gastric tissue is left or when the stomach is removed *in toto*. This type of anastomosis makes possible a wide area of serosal approximation without producing a stenosis. It prevents regurgitation of the intestinal contents into the stomach or into the esophagus and creates a large jejunal cavity acting as a substitute stomach.

In Case 6 a large ulcer was found on the lesser curvature near the cardia. This ulcer produced induration spreading along the anterior and posterior walls toward the greater curvature. After removal of most of the stomach there was only about 1 centimeter left of the lesser curvature near the cardia and only about 6 centimeters of the greater curvature. The lesser curvature was reconstructed by pulling in, and folding of the anterior and posterior stomach walls over the esophagus. The gastric remnant presented a short tubular bowel like structure with a tumor-like protrusion of the reconstructed lesser curvature into the gastric lumen. The gastric stoma measured no more than about  $1\frac{1}{2}$  centimeters. A standard gastrojejunal anastomosis would have resulted in an inadequate stoma. Because of the swollen and inflammatory gastric walls considerable inversion was required to assure a safe gastrojejunal anastomosis. Too much suturing in a standard type of anastomosis results in kinking of the jejunum at the proximal and distal angles of the stoma endangering a free passage for the gastric contents. A small gastric pouch with a narrow gastrojejunal stoma also favors regurgitation of the gastric contents into the esophagus. Consequently the double barrel technique appeared to have definite advantages in this particular case. The gastric stoma was enlarged by a generous incision of the gastric wall along the greater curvature. The enlarged gastric stoma was anastomosed to the jejunum by the double barrel technique. Since operation the patient has gained 20 pounds and follows no dietary restrictions (Fig. 5).

In another patient 72 years old, nearly the whole stomach was removed including the omentum because of carcinoma, and the operation performed in a similar manner. He later developed a very large jejunojejunal pouch a

substitute stomach (Fig 1) He has gained 55 pounds in weight He is symptom free and adheres to no dietary restrictions and is working as a laborer In cases of a total gastrectomy the terminal part of the esophagus can be incorporated into the double barrel jejunal sacculum without danger of stenosis or obstruction at the proximal or distal angles of the esophagojejunal anastomosis because of too much inversion It makes for a safer anastomosis and creates a valve like structure which allows for a free passage for the esophagus without the possibility of regurgitation from the intestine into the esophagus (Fig 8) The esophagojejunal anastomosis requires a great deal of attention and diligence and is more time consuming than the standard procedure Wide Halstead sutures should be avoided because they have a tendency to narrow the esophageal stoma.

#### SUMMARY AND CONCLUSIONS

A variation of gastrojejunal anastomosis utilizing a double barrel jejunal loop is presented This double barrel jejunal anastomosis embodies a Braun enteroenteroanastomosis and also a gastroenteroanastomosis in a single anastomotic procedure and without a break in continuity It prevents stasis in the afferent enteric loop and precludes an obstruction either at the proximal or the distal angles of the gastrojejunal anastomosis.

A double barrel method of gastrojejunal anastomosis was first introduced by the writer in 1934 as an experimental procedure in the studies on the etiology of postoperative jejunal ulcers.

A gastrectomy with a double barrel anastomosis was first applied in a patient with a duodenal ulcer in 1943 and later in 24 more patients with carcinoma and also with simple ulcer.

Thus far the clinical results of the operation are exceptionally favorable Most of the patients have gained weight and are free from the postgastrectomy symptoms which are not infrequent after the standard single loop gastrectomy.

The gastrectomy with the double barrel jejunojejunal anastomosis, because of the enteroenteroanastomosis and the valve-like for

mation of the gastrojejunal stoma prevents the entrance of the intestinal contents into the stomach The continuous reflux of intestinal juices into the gastric remnant results in severe gastritis, anorexia, nausea and vomiting causing chronic disability.

The double barrel gastrectomy has definite advantages in operation for carcinoma and for gastric ulcer and particularly in the presence of a minimal gastric remnant Because of the abundance of the intestinal wall from the jejunojejunal anastomosis a wider area of gastrojejunal approximation is permissible without endangering a free passage from the gastric pouch In addition a large jejunal sacculum is also formed which may compensate for the small capacity of the gastric pouch Roentgenographic examination of patients several months after operation shows that the double lumen sacculum enlarges with time.

The double barrel procedure is recommended for a total gastrectomy for establishment of the esophagojejunal continuity It prevents regurgitation of the intestinal contents into the esophagus and creates a large storage space, a substitute stomach.

Though it is apparent that the jejunal ulcers can be largely prevented by a properly performed radical standard gastrectomy the latter cannot always prevent those symptoms which are dependent on the reflux of the intestinal contents into the stomach.

Thus far personal experiments with the Y anastomosis of Roux and with the injection of histamine in beeswax yield some evidence that the double barrel anastomosis is possibly less prone to jejunal ulceration than the single standard procedure. Nevertheless the wider application of the double barrel gastrectomy for the treatment of duodenal ulcers will await more intensive experimentation in order further to evaluate its ability to protect the animal against the jejunal ulcer.

The double barrel anastomosis should instill caution and reserve commensurate with a procedure which is unconventional The success of the procedure requires more time and diligence than is required in the performance of the established operation Rehearsal on the cadaver and in the experimental laboratory will enable the surgeon to uncover details and



safeguards in the technique which he may not discern in the written page

Since this article was accepted for publication an additional 7 gastrectomies were performed by the pantaloons method. The results are most reassuring.

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# THE CERVICAL STUMP

## An Analysis of 123 Cases

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ALTHOUGH the medical literature is replete with articles on carcinoma of the cervical stump there is a paucity of reports concerning the other pathologic changes occurring in this organ. Since we have seen a great number of patients complaining of symptoms referable to the cervical stump which were not relieved by previous pelvic operations a critical analysis of all such cases of patients admitted to the Ochsner Clinic and Charity Hospital of Louisiana at New Orleans from January 1931 to July 1947 was undertaken in an effort to elucidate the other heretofore little discussed pathologic processes. There were 123 patients in whom the cervical stump was removed during this 16½ year period not including the innumerable patients with a cervical stump in whom symptoms were relieved by simple cauterization.

Forty or almost one-third of the patients in this series (32.5 per cent) had the same complaints for which the original pelvic operation had been performed. Of these 40 patients 23 had been subjected to only one operation—supravaginal hysterectomy usually combined with appendectomy. The other 17 had a supravaginal hysterectomy, bilateral salpingo-oophorectomy and appendectomy performed at various laparotomies. In these 17 cases although the entire internal female genitalia with the exception of the cervix had been removed the cervix was never recognized as the organ responsible for the symptoms.

### SYMPTOMATOLOGY

The most frequent complaints in this series are listed in Table I. Multiplicity of com-

Abstract of thesis submitted by Dr. Crawford to the faculty of the Graduate School, Tulane University, New Orleans, in partial fulfillment of the requirements for the degree of Master of Science in Gynecology and Obstetrics.

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plaints was of course the general rule. The commonest complaint was pelvic pain which occurred in 53.6 per cent of cases. This was described as lower abdominal pain involving either one or both sides of the iliac fossa usually chronic in nature rather ill-defined often worse just prior to the onset of the menstrual flow and aggravated by walking around or lifting heavy objects. Bearing down sensations occasionally accompanied this pain. Although the pain often simulates that caused by chronic diseases involving the lower abdominal organs such as adnexal disease, chronic appendicitis or diverticulitis, one of the commonest causes of it is a chronically diseased cervix. Sir James Young in 1930 was the first to recognize this important cervical lower abdominal pain relationship and to call attention to the diagnostic significance of a clinical procedure for reproducing the patient's symptoms. This test has failed to attract physicians in this country. The only references to it in the American medical literature have been by Holloway who in 1936 emphasized the importance of reproducing the patient's symptoms by applying tincture of iodine or silver nitrate to the cervix and by one of us (C. G. C.) who in 1938 again directed attention to reproduction of pelvic pain on motion of the cervix. A review of all current gynecologic textbooks reveals no reference to reproduction of pelvic pain which is caused by a diseased cervix. This is probably one of the reasons that erroneous diagnoses are made and that many of these patients have been subjected to needless or incomplete operative procedures.

The following clinical test has proved of great help in determining the part the cervical stump plays in the patient's symptoms. The examining fingers should first be inserted into one lateral fornix and the cervix pushed to the opposite side of the pelvis. For example, if

TABLE I.—SYMPTOMS

	No. cases	Per cent
Pelvic pain	66	53.6
Leucorrhoea	60	48.7
Bloody discharge	49	39.8
Dyspareunia	39	31.7
Backache	35	28.4
Urinary discomfort	40	3.3
Bearing down pain		17

TABLE II.—BLOODY DISCHARGE

Pathology	No. cases	Per cent
Cervical erosion and chronic cervicitis		42.8
Polyps	8	6.3
Epidemioid carcinoma	7	14.3
Endometriosis	5	10.2
Stricture	5	10.2
Fibroids	3	6.1
Total	49	99.9

the pain is on the right side the cervix should be pushed to the left with resultant tension on the right cardinal ligament and vice versa. The patient should then be asked not only

Does this hurt? but Is this the same pain of which you complain? A healthy cervix may be displaced considerably in all directions without discomfort and even maximum displacement, though uncomfortable, does not cause actual pain. However any attempt to displace a diseased cervix at once provokes the symptoms of which the patient complains. In the absence of palpable masses in the adnexa if lower abdominal pain can be reproduced in this manner one may be certain that the pain is cervical in origin. Reproduction of symptoms by placing stress on the base of the broad ligaments is probably due to the lymphatic drainage of the cervix, with concomitant mild or severe lymphangitis.

The second most frequent complaint in this series was profuse leucorrhoea, which is one of the most difficult of all pelvic complaints to evaluate. Most women believe that a certain amount of vaginal discharge is normal. All patients in this series complained of a leucorrhoeal discharge in addition to other symptoms. Sixty or 48.7 per cent complained of a discharge profuse enough to require daily douches or wearing of pads and all had this same complaint before supravaginal hysterectomy.

Forty-nine patients had a bloody vaginal discharge, 17 of whom complained only of bleeding following coitus or douches. The remaining 32 patients had an intermittent bloody vaginal discharge occurring without obvious trauma. The principal pathologic lesions in these cases of posthysterectomy bleeding from the cervix are shown in Table II. The chief cause was severe chronic cervicitis with erosion which constituted 42.8 per cent of the total. This was closely followed by polyps, carcinoma, endometriosis, stricture, and fibromy-

omas in the order named. Five patients had sufficient functional endometrial tissue to explain the bleeding.

Seven patients (14.3 per cent of the total number of cases) who complained of bleeding had carcinoma. This is a much lower incidence than the 46 per cent reported by Davis and Cheek.

Thirty-nine patients complained of deep-seated dyspareunia. This seemingly high incidence is probably relative though it exceeds that of most previous reports. Many patients are reluctant to admit having this symptom. If the patient is asked directly and tactfully she will admit with little or no embarrassment that this is the real reason for her consultation. Few volunteered this information but most admitted with great relief that though they had consulted many physicians in the past, this had been the first time that the question of painful coitus had ever been mentioned. Thirty-five of these patients had this same symptom prior to the original operation. Failure to relieve this symptom previously was probably due not only to lack of interrogation but also to failure to realize that a diseased cervix is a frequent cause of deep-seated dyspareunia. The pain is severe and is described as if something sore is being struck. It is often so intense as to prevent orgasm or to cause coitus to be discontinued. It may be followed by pelvic soreness or backache which may persist for 24 hours. With the exception of 2 patients who had endometriosis all these patients had moderate to severe chronic inflammatory changes in the cervical stump. Often the same pain can be reproduced by touching the infected cervix with the examining fingers or by manipulation of the indurated, uterosacral ligaments. Removal of the diseased stump was followed by complete relief in all 49 patients.

Low backache was a complaint in 28 per cent of cases. Although lumbosacral pain is one of the commonest complaints of women the diseased cervical stump can be implicated by a simple clinical test. Backache originating from a diseased cervix is usually localized in the sacral and coccygeal areas. It is aggravated just before or during the menstrual flow, by lifting a heavy object or by exertion and is relieved by reclining. It may be exacerbated during defecation. Existing concomitantly with cervicitis is lymphangitis of the uterosacral ligaments. Therefore by placing the uterosacral ligaments on stress the backache can be reproduced. This is accomplished by placing the fingers in the posterior fornix and lifting the cervix anteriorly. In a normal cervix this maneuver causes little or no distress. Removal of the cervical stump resulted in complete relief of this type of backache in all cases in this series.

In 1933 White was able to demonstrate experimentally that tubercle bacilli and India ink particles in the lymphatic channels of the bladder in animals were destroyed from 1 hour to 3 weeks following injection of these foreign materials into the cervix. He concluded that cervicitis is a constant companion of cystitis and that any attempt to treat cystitis or trigonitis is doomed to failure unless the neglected cervix is also treated. His observations have been confirmed by subsequent clinical investigations. Most urologists now realize this relationship and 4 of the patients in this series were referred directly by them. Discomfort in the urinary tract usually dysuria and frequency was a complaint in 32.5 per cent of cases. In cases with a coexistent cystocele or urethrocele stress incontinence of urine was noted. Some patients had been treated unsuccessfully for cystitis by local applications of silver nitrate and frequent soundings whereas upon removal of the infected cervical stump the urinary symptoms completely disappeared. It is also entirely possible that the diseased cervical stump may be the focus of recurrent pyelonephritis although there were no such cases in this series. The offending organism could conceivably reach the renal pelvis by way of the lymphatic channels of the bladder and the perireteral lymphatics. This focus

should never be overlooked as the original site of recurrent "pyelitis" in women.

Twenty-one patients complained of a bearing down sensation in the lower portion of the abdomen which was described as feeling as if the organs were falling out. This was always aggravated by any activity, such as hanging up and about on the feet, extended walks, lifting heavy objects, coughing, straining at stool, or by any condition which would tend to increase intra abdominal pressure. Fourteen of these 21 patients had a third degree prolapse of the cervical stump and the remaining 7 had second degree prolapse. Those who advocate supravaginal hysterectomy contend that one advantage of the procedure is that the cervix aids in support of the vaginal vault, a fact difficult to accept in the light of these figures. It is an easy matter to determine if the prolapsed stump is causing the patient's symptoms. One merely places a tenaculum on the posterior lip of the cervix and gently pulls downward. If this reproduces the same bearing down sensation then prolapse of the stump is causing the symptoms.

#### PATHOLOGY

The various pathologic processes noted in this series are listed in Table III. It is not meant to imply that such a high percentage of disease occurs in all cervical stumps, but it should be re-emphasized that these figures were obtained from cervixes which were considered sufficiently diseased to warrant surgical extirpation. It is unfortunate that the total number of patients with a cervical stump who were examined over the same period of years or the number who had pelvic complaints and were relieved by simple office cauterization is not available. We estimate that approximately 20 per cent of these patients required cauterization or surgical treatment. It is also regrettable that records of the previous surgical treatment were unobtainable. From these records could have been determined what treatment if any had been directed toward the cervix at the time the fundus was removed and the effect of such treatment on the subsequent clinical course.

It is apparent from Table III that multiplicity of lesions was the rule. For example

TABLE III—PATHOLOGY

	No. cases	Per cent
Chronic and chronic sub		
cervicitis	0	82.9
leucorrhea	3	26.9
Leucorrhea	5	4
Polyps	20	6.3
Endometriosis	5	4
Fibroid	4	3
Epidermoid carcinoma	7	5.7
Carcinoma		8

cervical polyps were frequently accompanied by severe chronic cervicitis and pyocervix was always associated with cervical stenosis. In 10 patients or 82.8 per cent the pathologic report was chronic cervicitis or chronic cystic cervicitis. In 52 cases it was the only lesion noted. In the remaining cases also present were polyps strictures prolapse and other pathologic processes which undoubtedly played a role in the production of symptoms. Of the 2 patients in whom infection alone was noted the order of frequency of symptoms was pelvic pain dyspareunia, leucorrhea abnormal bleeding urinary difficulties and backache. It is noteworthy that 22 or 43 per cent of the group had had a previous supravaginal hysterectomy to correct the complaints from which they obtained no relief until the cervical stump was subsequently removed. It is thus obvious that incomplete or unnecessary surgical procedures had been performed because of failure to recognize the important role the cervix plays in the symptomatology of pelvic disease. It is hoped that the clinical tests discussed under symptomatology will enable the physician to make a more positive diagnosis of pelvic lesions and thereby prevent such mistakes in the future.

Thirty-two patients had stenosis of the cervix os. Many advocates of supravaginal hysterectomy advise routine cauterization or conization of the cervix at the time of hysterectomy. Since the patients in this series were operated on previously elsewhere, it was impossible to determine what percentage of stricture existed prior to the original operation or developed as the result of or subsequent to the operation. It is probable however that the majority developed as a result of such procedures as cauterization or conization of the cervix at the time of hysterectomy. Only 24

per cent of patients with stricture had the same complaints prior to the initial operation, in the remaining 76 per cent symptoms developed after the operation. It may be assumed then that in this latter group stricture developed as a result of some procedure on the cervix at the time of the operation. Noteworthy are the 5 cases of stricture with resultant empyema of the cervix. These 5 patients were wholly or partially disabled. Surgical extirpation of the cervical stump was followed by complete relief of symptoms and resumption of normal activity for the first time in years. Three of these patients had been running a low grade fever with arthritis or arthralgic symptoms for years. These symptoms disappeared following removal of the stump.

Twenty patients had benign endocervical polyps. As would be expected, these polyps were associated with rather severe chronic infection. Eight patients complained of postcoital bleeding. This was the most frequent complaint followed closely by leucorrhea, dysuria, and pelvic pain in the order named. The average interval between hysterectomy and removal of the cervical stump in our entire series was 8.4 years. Due probably to the patient's alarm over the vaginal bleeding the interval between hysterectomy and extirpation of the cervical stump was only 6 years in the group in which polyps were the chief pathologic finding.

Since cervical endometriosis is a rather rare condition it was surprising to find endometriosis of the cervical stump in 5 cases—an incidence of 4 per cent. Goodall (7, 8) believes that cervical endometriosis is always secondary to uterine endometriosis by extension into the fibromuscular tissues of the cervix. In all these cases hysterectomy had been performed for fibromyomas. It is probable that endometriosis of the fundus or adenomyosis existed unrecognized at the time in some of these. Irregular vaginal bleeding either postcoital or without apparent cause was a complaint in all these patients. Other symptoms were pelvic pain dyspareunia, and backache in the order named. In 1 case there was a cervical fibroid in conjunction with endometriosis. In all but 2 of these cases the ovaries had been extirpated at the time of the original hysterectomy. One

patient had had previous radium castration and 1 was past the climacteric. The problem of destruction of ovarian function was therefore not encountered.

It has been estimated that cervical fibroids account for 3 to 8 per cent of all cases of fibroids encountered. Fibroids of the cervical stump are rare. Giles was able to collect only 6 cases to which Hyams added 4, making a total of 10 cases reported in the literature. There were 4 patients in this series with fibroids. These patients complained of vaginal bleeding, urinary frequency and pelvic pain in the order named. All had previously undergone hysterectomy for fibromyomata but endometrial or myometrial tissue was preserved in all. It is believed that these cervical fibroids probably developed in the remaining myometrial tissue. Therefore retention of sufficient endometrial tissue for the preservation of menstrual function would seem to be not without some danger.

The reported incidence of carcinoma of the cervical stump has varied from 0.45 to 7.2 per cent (1, 2, 4, 8, 9, 15). The incidence of 5.7 per cent (7 cases) in this series is by no means a true incidence of the disease. It is indicative merely of the incidence of carcinoma in the 123 cases in which operative removal of the cervix was deemed necessary. Vaginal bleeding or spotting was observed in all 7 cases. Five patients complained of profuse leucorrhea and 1 of pelvic pain. In 3 cases carcinoma was diagnosed by biopsy, radium was inserted and this was followed by surgical removal. In 1 case early carcinoma *in situ* was diagnosed and the cervical stump was removed without previous radiation. In the last 2 patients 1 of whom complained of contact bleeding, repeated biopsies yielded normal results but after removal early epidermoid carcinoma was positively identified by microscopic studies.

Davis and Cheek believe that every patient who complains of vaginal bleeding following supravaginal hysterectomy should be subjected to a cervical biopsy and curettage of the endocervical canal. We prefer biopsy followed by surgical extirpation of the entire cervical stump.

In 1 case the biopsy report was chronic granuloma of undetermined type. This pa-

tient's chief complaint was profuse purulent leucorrhea which was accompanied by pelvic pain and by backache. Removal of the granuloma of the stump resulted in complete relief of symptoms.

#### TREATMENT

Prophylaxis is always an important part of treatment of any disease and is particularly significant in this condition. Since 32.5 per cent of the patients in our series had had one or more previous operations for the identical complaints for which they consulted us, it may be assumed that the causal relationship between the cervix and their symptoms was not recognized at that time. A diseased cervix should always be suspected in any woman with pelvic pain, dyspareunia, contact bleeding, backache, leucorrhea and urinary difficulties. The diagnosis may be easily established by the clinical tests already described. If hysterectomy is indicated for associated pelvic pathologic conditions, the uterus should be removed *in toto* whenever this procedure is technically possible.

Preservation of sufficient endometrium to allow the patient the privilege of menstruating has already been shown to be not only useless but oftentimes dangerous. Further more, preservation of the cervix in order to provide proper support for the vagina has also been shown to be a fallacious argument. Should it be technically impossible or not expedient to remove the cervix at the time of hysterectomy, the patient must be warned that it remains and that periodic examinations are necessary. No patient is more pathetic than the one who has been lured into a false sense of security by being told that the uterus has been removed and that she will have no further trouble only to discover years later that carcinoma or some other serious pathologic lesion has developed in the remaining cervical stump. When hysterectomy is performed on our service the entire uterus is always removed if possible. The technique used in these cases has been previously described by Tyrone and Weed (14). If the cervix is not removed at the time of hysterectomy, it is removed by the vaginal route as soon as the patient's general condition permits. This has also been the practice in large gynecologic clinics through-

out the country and more and more total hysterectomies are being performed daily. Prophylactic treatment, therefore, consists in first the diagnosis and treatment of the diseased cervix itself prior to operation and second performance of total hysterectomy whenever removal of uterus is indicated.

The definitive treatment of the diseased cervical stump presents an entirely different problem. We do not adhere to the older concept that management of the diseased cervical stump does not differ from treatment of the diseased cervix when the uterus has not been removed. If routine examination reveals an asymptomatic, normal cervical stump then the patient should be warned of its existence and cautioned to have periodic examinations. If there is first or second degree asymptomatic prolapse of the cervical stump only careful observation is indicated. If third degree prolapse is present, regardless of symptoms, the cervix should be removed and the vaginal vault resupported. Regardless of the degree of prolapse, however if prolapse is causing pelvic pain or bearing down sensations (which may be reproduced by pulling on the cervix with a tenaculum) then it is necessary to extirpate the organ as well as repair the prolapse. These general rules for prolapse of the stump are applicable even to elderly or debilitated patients. The operative procedure is a simple one with no shock. The peritoneal cavity is not necessarily opened and early ambulation with few or no complications is the rule.

TeLinde believes it safer to remove a cervical stump transabdominally. He states that as a result of peritonealization of the cervical stump at the time of supravaginal hysterectomy the bladder is intimately bound to it and consequently the 'blind dissection' from below endangers the bladder resulting in a large percentage of vesicovaginal fistulas. Our experience does not substantiate his views, for there were no fistulas in our entire series although the stump was removed by the vaginal route in 121 cases and by the transabdominal route in only 2 cases.

Simple erosion and superficial infection of the retained cervical stump may be cauterized with the actual cautery in the office and the

patient should return in 6 weeks for sounding of the canal to preclude the possibility of the development of a stricture.

The results of cauterization in cases with long standing chronic infections with considerable hypertrophy endocervicitis, nabothian cysts, and parametritis have been generally poor. Once the infection has reached this stage and is responsible for the pelvic pain, the backache, dyspareunia, leucorrhoea and the urinary discomfort, the only certain method of cure is the complete removal of the cervical stump.

Strictures of the cervical canal in our series probably could have been prevented by removal of the entire uterus at the time of operation rather than by reliance on the supra vaginal route and cauterization of the cervix. Others might have been prevented by proper follow up examination after cauterization, or by realization that the diseased process in the cervical stump was too far advanced to respond to cauterization. If the stricture has already developed but there are no symptoms, repeated office dilatations are of little benefit. The only corrective measure, therefore is surgical excision. Of course, once empyema of the stump has developed, removal is mandatory.

Polyps of the cervical stump should all be removed and studied microscopically. If the polyps are causing no symptoms and are not superimposed on a chronic infection removal of the polyp with cauterization of the base may be the only treatment necessary. However if the polyps are causing such symptoms as contact bleeding and leucorrhoea and are superimposed on a chronic inflammatory process severe enough to cause symptoms, then surgical extirpation is indicated.

It has already been stated that biopsy should be performed on any cervical stump from which there is bleeding and then the stump should be removed *in toto* except in cases of advanced carcinoma of the stump. It is believed that excision is mandatory in spite of the fact that results of previous biopsies may have been reported as merely chronic infection.

Carcinoma of the cervical stump should be treated by the application of radium or roent

gen ray or by excision depending upon the type and the clinical stage. The management of carcinoma of the cervical stump will not be discussed here but it is mentioned because 7 cases were encountered in this series. The reader is referred to the bibliography for the many excellent articles on this subject (1 2 4 9 15).

Endometriosis of the retained cervix is usually secondary to pelvic endometriosis either being maintained by persistent ovarian function or by replacement hormone therapy. If asymptomatic, careful observation is advocated. If symptomatic, as were all the cases in our series, surgical removal coupled with roentgen therapy administered for the express purpose of causing cessation of function of remaining ovarian tissue is indicated. Estrogenic replacement therapy if being given should of course be discontinued.

Fibroids of the cervical stump even though symptomless should be extirpated with the cervix. All in this series caused symptoms. Whenever they occur it is believed that the patient is materially benefited by their removal.

Other authors in discussing the treatment of various pathologic conditions of the retained cervix, advocate repeated deep cauterization, conization and amputation. In our series 22 patients had been subjected to such procedures without alleviation of symptoms. It must be stressed then that the only method of relieving symptoms and curing the entire pathologic process if hypertrophy and hyperplasia are present, is complete extirpation of the stump.

#### RESULTS

There were no deaths or complications in this series of cases (Table IV). It is believed that the technique recommended entails no hazard to the bladder or ureter. Of the 123 patients 109 were completely relieved of symptoms. In 11 of the 14 remaining cases there were no follow up examinations. Since 8 of these 11 patients failed to return for follow up examinations it may be assumed that they were not completely relieved. The 3 others were operated upon too recently for follow up examination. There were 3 other patients in

TABLE IV — RESULTS

	No. cases	Percent
Mortality	0	0 0
Morbidity	0	0 0
Completely relieved	109	88 6
No follow-up examination	11	8 9
No relief	3	2 4
Total	123	

this series who were either not relieved or only partially relieved. One was relieved of all difficulties except urinary frequency and dysuria which also failed to respond to urologic treatment. One patient who experienced no relief was found on follow up examination to have a cystic mass in the right adnexa, about 8 centimeters in diameter. This case was probably diagnosed incorrectly. The third failure was a patient, complaining of pelvic pain, dyspareunia, leucorrhea, dysuria and frequency who had had previous supravaginal hysterectomy, appendectomy and cholecystectomy for the same symptoms. It was believed that all her symptoms were arising from an infected cervical stump. The cervix was removed vaginally and at the same time an incisional hernia was repaired and bilateral salpingo-oophorectomy was performed. She was examined many times postoperatively but she continued to have the same complaints for which no urologic or gynecologic cause could be found. Examination of this patient by Dr. Curtis Tyrone (13) who removed the cervical stump revealed that a portion of the cervical stump remained. He states that at the time of removal he merely amputated the cervical stump, brought the cardinal ligaments together at the midline, and sutured the vaginal mucous membrane over this structure similar to a Spalding-Richardson procedure. At the latest operation performed less than a week ago he found an old abscess behind the vaginal vault involving the portion of the cervical stump which was remaining. This patient is now completely relieved of symptoms.

#### SUMMARY

1. Methods of diagnosis of symptoms which arise from a diseased cervix have been described.

2. The performance of total hysterectomy in all indicated cases is urged.



3 The symptomatology pathology and treatment of 123 patients in whom the cervical stump was removed are discussed.

4. The importance of recognizing the cervical stump as the origin of many patients complaints is emphasized.

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# INGUINAL AND FEMORAL HERNIOPLASTY

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IN the years between 1938 and 1943 the authors reported upon studies concerned with the anatomy of the inguinal and femoral regions.<sup>1</sup> Certain inaccuracies in the conventional accounts of these regions were pointed out and detailed features were described and figured. It became apparent early that some of the older misconceptions accounted for the confusion that exists concerning the repair of inguinal and femoral hernias, and that some of the principles laid down for their operative correction found meager basis in anatomic structure.

Since completion of the morphological study the senior author has applied the resulting principles to the repair of inguinal and femoral hernias. In the current article the authors will record steps in the operation now rather widely employed<sup>2</sup> and will present a series of one hundred cases of groin hernia operated upon by the method to be described.

## MATERIAL AND METHODS

The surgical material upon which the authors' account is based consists of 100 consecutive operations for indirect inguinal, direct inguinal or femoral hernias and anatomic studies made during the past 14 years. The illustrations were prepared from dissections upon male cadavers, the successive surgical steps duplicating those followed in actual hernioplasty.

Admittedly, the surgical series is small, a fact which calls for some explanation regarding the type of hernias repaired and the time interval represented in the follow up. It is

the conviction of the authors and others (Bartlett 1946) that the small indirect inguinal hernia, which constitutes the majority of groin hernias, should have no recurrence rate if properly evaluated at the time of operation and that therefore it is the large indirect, the direct inguinal and the femoral hernias that constitute the problem in hernia repair. Although the two procedures will be described in detail, it is essential in examination of the tabulated statistics to recognize that the abdominal ring repair (illustrated in Fig. 2) is used only in the small indirect inguinal hernia and that the procedure for all the others being the same is called reconstruction of the inguinal wall (illustrated in Figs. 3, 4 and 5).

The series of 100 cases is divided into two parts: 35 patients operated upon at the University Hospital, Ann Arbor, Michigan, between the years 1939 and 1943 (Table II) and 65 patients operated upon at Yankton, South Dakota, in the 18 months between January 1, 1946 and July 1, 1947 (Table III). In the interval between 1943 and 1946 the senior author served with the 298th General Hospital and although many hernias were repaired during that period by the method hereinafter described, no record of surgical result was kept.

Reference to the tabulations (in which the hernias are separated into groups) will reveal that in the first group the interval since operation is 5 to 8 years but the follow up is incomplete and in the second group the elapsed time is too short (10 to 28 months) to state definitely that there will be no recurrence. However, it is worthy of note that of the 100 cases, 56 of the hernias can be classified as difficult to repair (of which 12 were recurrent) and that to date there has been no known recurrence.

Comparison of the two groups of cases will illustrate the difference in the type of hernia

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TABLE I.—INCLUSIVE SUMMARY BY TYPE OF OPERATION (COMPARE TABLES II AND III)

Type of operation	No. of cases	Recurrence
Abdominal ring repair	44	none
Reconstruction of inguinal wall	56	none
Total	100	none

encountered in a large charity institution as compared with the incidence of the various types encountered in private practice. In general, it can be stated that patients with the more difficult hernias tend to enter the large institutions, and that about twice as many recurrent hernias are seen in such hospitals as in private practice. The reversal of the ratio between those requiring simple repair of the abdominal ring and those requiring a reconstruction of the inguinal wall is apparent in the two series of cases.

## GENERAL CONSIDERATIONS

*A Anatomy* It seems unnecessary here to describe the detailed anatomy of this region since the authors have done so in earlier articles. However there are certain fundamental anatomic facts that must be clearly understood if the rationale of the authors procedure is to be understood. The inguinal ligament plays no role in either operation no sutures are placed in it it is freed by blunt dissection to demonstrate more clearly the underlying femoral sheath and open the way to

the superior pubic (Cooper's) ligament. It is not generally appreciated that the inguinal ligament is a free margin and that, inferior to this aponeurotic edge the fasciae that invest either surface of the external oblique aponeurosis are continued into the thigh as the fascia lata (McVay and Anson, 1940). When the inguinal ligament is freed and retracted inferiorly (caudally) as described later under technique it is simply shelled out of this fascial bed.

The posterior inguinal wall is a composite layer consisting of the most caudal portion of the transversus abdominis aponeurosis and its investing fasciae (Figs. 1a and 1b) the fascia on the inner or peritoneal surface is the transversalis fascia (Fig. 1b). Whereas the transversalis fascia is easily separated from the transversus muscle laterally (Fig. 1b) in the medial area where the muscle becomes aponeurotic, the fascia and the aponeurotic fibers are for all practical purposes fused. The strength of the posterior inguinal wall is directly proportional to the number of aponeurotic fibers it contains. Caudal to the point where aponeurotic fibers of the transversus contribute to the rectus sheath, the insertion is into the superior pubic (Cooper's) ligament this insertion continues laterally to the medial margin of the femoral ring (Fig. 1b). Although aponeurotic fibers terminate at this point, the transversalis fascia is carried inferi-

TABLE II.—SERIES AT UNIVERSITY HOSPITAL, ANN ARBOR, MICHIGAN 1939-1943

Type of hernia	No. of cases	Type of repair	No.
Small indirect inguinal	4	Abdominal ring repair	4
Large indirect inguinal	6		
Direct inguinal		Reconstruction of inguinal wall	
Femoral	3		3
Total	35		35
			Cases
Primary hernias			15
Indirect recurrence			3
Direct recurrence			1
Femoral recurrence			—
Total			35
Follow-up 947			
N recurrence			3
Known recurrence			0
No follow-up			4
Total			35

TABLE III.—SERIES AT SACRED HEART HOSPITAL, YANKTON SOUTH DAKOTA THE YANKTON CLINIC JANUARY 1946 THROUGH JUNE 1947

Type of hernia	No. of cases	Type of repair	No.
Small indirect inguinal	40	Abdominal ring repair	4
Large indirect inguinal	1		
Direct inguinal	18	Reconstruction of inguinal wall	35
Femoral	3		65
Total	65		65
			Cases
Primary hernias			60*
Indirect recurrence			8
Direct recurrence			1
Femoral recurrence			—
Total			65
Follow-up April 948			
N recurrence			65
			*Ta patients had been previously injected with a sclerosing solution.

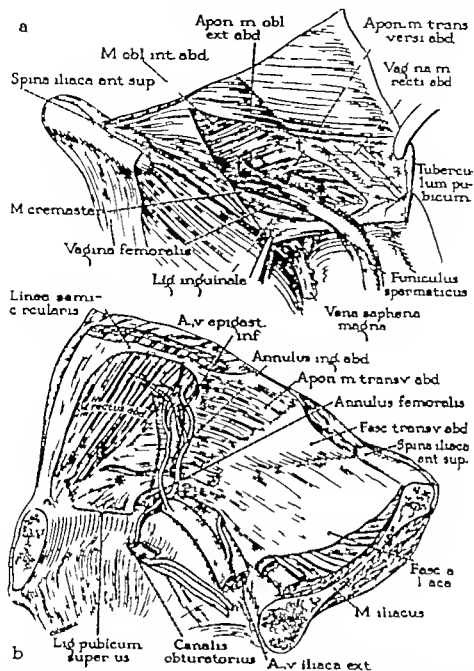


Fig 1 a. The inguino-femoral region anterior view. Dissections of a cadaver in which the skin and subcutaneous fascia have been completely removed. The external oblique aponeurosis has been opened in the direction of its fibers, beginning at the subcutaneous inguinal ring and extending superolaterally. The incision duplicates that used in the repair of inguinal hernia. The inguinal ligament, freed from its fascial bed, has been retracted inferiorly to demonstrate the femoral sheath (as in all of the following hernial repairs). The superior flap of external oblique aponeurosis is pulled superomedially to demonstrate the underlying rectus sheath. The latter is incised, for relaxation of the layer in the "reconstruction" of the inguinal wall. Next beneath the delicate cremaster fascia has been cut (at  $\dagger\dagger$ ) near the junction of the internal oblique with the cremaster muscle. The cord has been drawn inferiorly

to expose the posterior inguinal wall, the transversus abdominis aponeurosis and fascia (at  $\times$ ). Defects in this layer constitute the problem in the three major types of groin hernia. b The same specimen the inguinal wall from within. Peritoneum and preperitoneal connective tissue have been removed. The line bracketed for the superior pubic ligament records the normal length of the insertion of the transversus abdominis aponeurosis into the ligament. Neither the inguinal nor the lacunar ligaments are visible at this stage of the dissection, although they are invariably pictured in textbooks which illustrate this posterior view. Actually the transversus conceals these ligaments. The point at  $\times$  is similarly marked in Fig 1a for orientation. It is approximately central in the area of Hasselbach's triangle, with whose wall the problem of hernioplasty is chiefly concerned.

only through the vascular lacuna as the anterior layer of the femoral sheath (Figs 1a and 1b). Medially, at the lateral border of the

rectus muscle the transversus aponeurosis passes anterior to the rectus muscle thus contributing its substance to the rectus sheath

(below the linea semicircularis) the transversalis fascia on the contrary divides to invest the rectus muscle thus forming the rectus fascia. The internal oblique muscle as a rule lies superior to the area with which the present account is concerned. The latter is not a factor in groin hernias hence it does not enter into the repair unless it is aponeurotic—and then it is included in the sutures.

The important feature in the anatomy of the inguinofemoral region as it pertains to the three types of groin hernia is their dependence (small indirect variety excepted) upon a defect in the same layer. This layer is the transversus abdominis aponeurosis and its investing fasciae in the area of Hesselbach's triangle. This area may conveniently be referred to as the posterior inguinal wall (Figs. 1a and 1b). A direct inguinal hernia presses forward directly through this aponeuroticofascial layer (Fig. 4a). A large indirect inguinal hernia encroaches upon it from the lateral side (Fig. 3a) in those cases in which the medial wall of the neck of the indirect hernia lies against the rectus muscle; the posterior wall is completely destroyed forming in an attenuated state part of the covering of the base of the hernial sac. In a femoral hernia the femoral ring is enlarged medially at the expense of the insertion of the posterior wall into the superior pubic ligament (Fig. 5a) and is thus a narrowing of the insertion of this layer. Whether the etiology of a femoral hernia is in part due to a congenitally narrow insertion of the posterior wall into the superior pubic ligament the authors are not prepared to say. However it is important to record that in a series of cadavers variation in the breadth of this insertion was observed with corresponding variation in the width of the femoral ring. In cases of femoral hernia the femoral ring is invariably enlarged medially at the expense of this insertion and the medial wall of the ring lies against the lacunar ligament. This circumstance accounts for the misleading statement that the medial wall of the femoral ring is the lacunar ligament.

**B. Surgery.** In the second group (Table III) comprising 65 cases the patients were ambulated on the first postoperative day, skin sutures removed on the fifth and the patients

discharged on the fifth to seventh postoperative day. Patients with abdominal ring repair were allowed unlimited activity 2 weeks after operation; those requiring complete reconstruction of the inguinal wall were allowed light duties in 2 weeks, and unlimited activity 1 month after operation. The distinction between light and heavy work has been made, because most members of this group of patients are farmers whose regular duties would call for heavy lifting and riding such vibrating machines as tractors, combines, and mowing machines.

Advanced age was not regarded as a contraindication to the repair if the patient's general physical condition was good and his symptoms were incapacitating. Five members of this group were in the sixties, 3 in the seventies, and 1 was 82; all of them were actively farming and the hernia in each case had proved to be incapacitating. Of the 4 patients over 70 years of age all had experienced episodes of incarceration; none could wear a truss satisfactorily. There was 1 death in the total number of cases (100) in a man 56 years of age; he succumbed on the seventh postoperative day from a pulmonary embolism (as established by autopsy). Death occurred as he was preparing to leave the hospital; he had been ambulatory much of the time since the first postoperative day.

No primary wound infections occurred. However 2 cases of abdominal ring repair later developed sinus tracts which necessitated the removal of a medium silk mattress suture<sup>1</sup> employed for closure of the abdominal inguinal ring. In each instance, the cause was a technical error: too large a loop of silk had been used. In the group that had undergone complete reconstruction of the inguinal wall there was no instance of wound infection or of extrusion of silk—thus, despite the fact that the suturing (with medium silk) was more extensive than in the cases requiring mere closure of the abdominal inguinal ring.

The skin incision employed is transverse. It serves equally well for the repair of the three types of groin hernia and incidentally it

<sup>1</sup>The term "medium silk" as used in this paper refers to No. 30 braided black silk. The term fine silk refers to No. 0000 braided black. R.

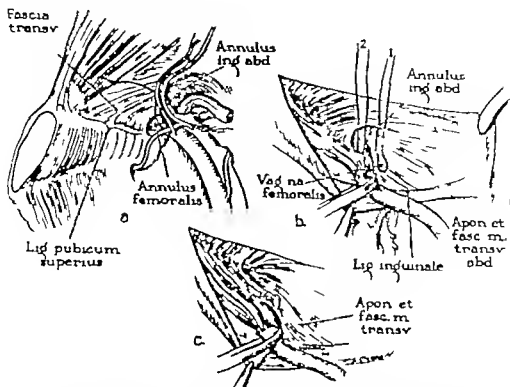


Fig 2 a. The inguinal region posterior view. A case of small indirect inguinal hernia. Peritoneum, preperitoneal connective tissue and the hernial sac have been removed to show that in such instances the inguinal region is normal except for slight dilatation of the abdominal inguinal ring. The diameter of the femoral ring is normal as is, likewise, the extent of the pubic ligamentous insertion of the transversus abdominis aponeurosis. b. The inguinal region anterior view. Depicting repair of a small indirect inguinal hernia. The hernial sac has been ligated, excised and retracted out of view. Two sutures have been placed. The first brings together the transversalis fascia and the anterior layer of the femoral sheath. Thereby the slightly dilated abdominal inguinal ring is reduced to normal size. The second suture transfixes the fasciae of the cord to the transversalis fascia, thus preventing subsequent protrusion of lobules of preperitoneal fat. The main area of the posterior inguinal wall, being normal, remains undisturbed. The cord has been drawn lateralward to demonstrate the continuity of the transversalis fascia with the anterior layer of the femoral sheath. c. Concluding the surgical steps, the two sutures have been tied and the abdominal inguinal ring closed. The spermatic cord has been returned to a position again; the posterior wall, the external oblique aponeurosis will be closed over it.

gives a much superior cosmetic result.<sup>1</sup> The classical incision begins at the pubic tubercle and passes superolaterally, dividing the angle between the inguinal ligament and the linea semilunaris; it cuts across the skin lines (of Langer) and usually leaves a poor scar. The present authors prefer an incision made almost transversely from the level of the abdominal inguinal ring to within 1 centimeter of the midline. The abdominal ring is projected on the skin surface by taking a point half way between the pubic tubercle and the anterior superior iliac spine. The inclination of the in-

cision medially varies slightly from the obese to the asthenic patient, yet follows the lines of Langer.

The subjacent aponeurosis of the external oblique is next divided in the direction of its fibers from the position of the subcutaneous inguinal ring in a superolateral direction to a point 2 or 3 centimeters above the abdominal inguinal ring. The superomedial flap is then developed to its point of fusion medially with the underlying internal oblique aponeurosis. The inferolateral flap is next developed to the inguinal ligament, which is then freed from its fascial bed.

The spermatic cord and the investing cremaster muscle are carefully elevated from the

<sup>1</sup>The senior author began using the transverse incision for heriorthaphy in 1911, after observing it, as by Dr. F. A. C. Her. More recently it has been described by Chamberlain.

inguinal canal by incising the delicate cremaster fascia at the junction of the cremaster and internal oblique muscles (Fig. 1a) This is done for each of the three types of groin hernia. Extreme care must be exercised in order to avoid damage to the underlying posterior inguinal wall, which consists of the transversus abdominis aponeurosis and its investing fasciae (Figs. 1a and 1b)

At this point in the operative procedure the surgeon should make the initial evaluation of the posterior inguinal wall noting the strength of the aponeuroticofascial transversus layer and examining for intrinsic defects. Then examination for the presence of an indirect inguinal hernia must be made. Should such be found its distorting and attenuating effect is to be evaluated. If the hernia is direct the weakened and thinned portion is to be excised. Subsequent steps in the operation will be described later. If a femoral hernia has occurred the layer is to be incised just above its insertion into the superior pubic (Cooper's) ligament for maximum conservation of the layer. Even though the hernia is obviously femoral or direct inguinal the structures of the spermatic cord should be separated down through the abdominal inguinal ring in a careful search for even a very small indirect sac. Scrutiny is important, since without question some of the recurrences, in the presence of an indirect sac (intimately associated with the cord and surrounded by the fasciae of the cord) are due to failure to detect such a congenital indirect sac at the time of the first operation.

When the hernia is of the indirect type following completion of the initial inspection of the posterior wall the sac should be partially separated from the muscular structures and fascia, and opened. The index finger is then introduced into the sac, next through the neck at the abdominal inguinal ring. The strength of the posterior inguinal wall is determined by a combination of palpation from the peritoneal side and inspection anteriorly the size of the abdominal inguinal ring is simultaneously noted. In the course of the examination the femoral ring is palpated to rule out a femoral hernia. If repair of the abdominal ring is all that is necessary the sac is completely freed

ligated high and excised. If reconstruction of the inguinal wall is indicated then the complete dissection of the sac awaits the resection of the attenuated portion of the posterior inguinal wall the greater exposure makes high ligation of the sac easier.

Unfortunately no hard and fast rule can be laid down as to just what strength and appearance of posterior wall indicate need for reconstruction and which do not. Neither can it be stated didactically just how large the abdominal inguinal ring should be to justify the reconstruction operation. Both of these decisions must depend upon the judgment of the surgeon. It is worthy of note, however, that this posterior inguinal wall (the transversus abdominis aponeurosis and fused fasciae) is never as strong as certain other aponeurotic layers, such as the rectus sheath. The wall can be thin to the point of translucency and yet be adequate. Many elderly patients operated upon for a small indirect inguinal hernia have not developed a direct inguinal hernia—despite their advanced age. In a general way it can be stated that if the abdominal ring is dilated to more than 2 centimeters in diameter there is sufficient encroachment into the area of direct inguinal hernia (Hesselbach's triangle) to necessitate the reconstruction of the entire posterior inguinal wall.

#### SURGICAL TECHNIQUE

*A. Abdominal ring repair.* This procedure is followed in caring for the small indirect inguinal hernia (Figs. 2a to 2c). They represent the majority of groin hernias. The use of the word small does not refer to the length of the sac but to the diameter of the abdominal inguinal ring.

After opening the sac and making sure that no femoral hernia or direct inguinal hernia exists, the surgeon dissects the sac free of all cord fasciae and related structures proximal ward through the abdominal ring. Ligation is done with a chromic catgut suturing suture, and the sac is excised (Fig. 2b). After ligation and excision of the sac, the ligated neck should retract at least 2 centimeters above the fascial abdominal ring. If it does not the fact indicates that dissection has not been

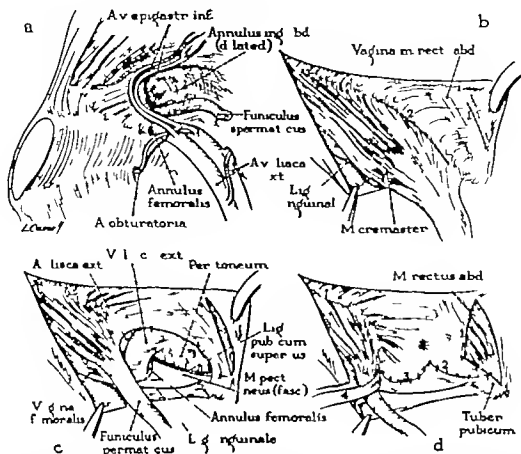


Fig 3 a, The inguinal region posterior view. Simulating a case of large indirect inguinal hernia. Peritoneum, preperitoneal connective tissue and the hernial sac have been removed to demonstrate the aponeuroticofascial defect. The abdominal inguinal ring is greatly dilated, and the inferior epigastric vessels displaced medialward to the edge of the rectus abdominis muscle. More than half of the posterior inguinal wall has been compromised by the dilatation of the abdominal inguinal ring yet there is no direct inguinal herniation and the femoral ring is normal in size. b, The same specimen anterior view. The spermatic cord is enlarged, owing to the contained large indirect hernial sac and to hypertrophy of the fascial investments of the cord. The inguinal ligament has been pulled inferiorly to expose the underlying femoral sheath. The superior flap of the external oblique aponeurosis has been drawn medialward to demonstrate the manner in which it fuses with the internal oblique aponeurosis to form the rectus sheath. The relaxing incision is made just lateral to this line of fusion (dotted line at 1). A second incision is made between the strong portion of the posterior wall, and the area attenuated by the enlarged abdominal ring (dotted line at 2). c, Continuing the procedure, the incisions (represented by the numbered lines in Fig 3b) have been

made, and the thinned portion of the posterior wall has been excised completely. The femoral sheath and superior pubic ligament are exposed. The investments of the spermatic cord have been trimmed to normal size by excising the now redundant fascial coverings. The new strong, lower margin of the transversus abdominis aponeurosis (posterior wall) will be sutured to the superior pubic ligament, in the area from the pubic tubercle to the femoral vein, and from this latter point the transversalis fascia will be sutured to the anterior wall of the femoral sheath (dotted line indicating the line of suture). d, Concluding the procedure, the strong posterior wall has been sutured to the superior pubic ligament (at 1) and the anterior layer of the femoral sheath (at 3, along the dotted line illustrated in Fig 3c). The spermatic cord (at 4) has been drawn farther lateralward to show the line of suture as it extends upward and to close, the abdominal inguinal ring. The relaxing incision (at 2) is now an open triangular defect protected behind by the lower end of the rectus muscle and its tendon of pubic origin. The lateral margin, retracted and angular is usually sutured to the underlying tendon of the rectus abdominis. This step completes the repair. The spermatic cord is replaced against the posterior wall and the external oblique aponeurosis is closed over it.

high enough. Dissection of the hernial sac is carried out with a scalpel and should extend in the bloodless field of loose areolar tissue immediately adjacent to the peritoneum of the sac.

Thus far the description is a restatement of the fundamental problem presented by this type of hernia and one recognized since the

time of Bassini. In addition to the peritoneal processus vaginalis the surgeon will frequently encounter pedunculated protrusions of the preperitoneal layer of fascia and fat among the structures of the cord. They vary in number from one to several; they should be dissected free up through the abdominal ring ligated and excised. Ligation is important



since they contain a vascular stalk. They should be removed for two reasons first because a small abdominal inguinal ring cannot be made while such protrusions remain within it second because they are likely to act as an entering wedge for recurrent herniation through the abdominal inguinal ring (consonant with Cloquet's concept regarding the role of lipoma in epigastric hernia)

Following ligation and excision of the sac, the fascial margins of the abdominal ring are identified. The cord is pushed lateralward and the abdominal inguinal ring is snugly closed medial to the spermatic cord by one or two medium silk mattress sutures these approximate the transversalis fascia to the subjacent anterior layer of the femoral sheath (Fig. 2b suture 1). That these are merely portions of the same layer can be demonstrated at the medial margin of the ring. An additional fine silk suture is placed within the ring in the manner of a pursestring which serves to gather the fascia of the cord at several points, approximating it to the transversalis fascia above (Fig. 2b suture 2). The last suture serves to close completely the abdominal inguinal ring and to prevent subsequent protrusion of lobules of peritoneal fat through the ring.

The abdominal ring is considered closed if the tip of the little finger can be inserted through the ring along with the cord structures. With the use of such closure there have been no cases of postoperative edema of the testis or of subsequent atrophy of the testis. The remainder of the procedure consists simply in dropping the cord back into normal position and closing the external oblique aponeurosis over it with the use of interrupted fine silk sutures. The subcutaneous inguinal ring is made just small enough to prevent an examining finger from passing through it. It is important to note that not a single suture is passed through or into the posterior inguinal wall. In this type of hernia the authors consider anything other than abdominal ring repair not only unnecessary but inadvisable. Initial appraisal (with a palpating finger through the neck of the hernial sac) having indicated that the wall is sufficiently strong to contraindicate reconstruction (hereinafter)

and that no femoral hernia is present, suturing in the standard kind of repair would only expose the patient to the possibility of a direct recurrence through a suture hole or a tear. While performing some other lower abdominal operation an indirect inguinal hernia may be repaired after the method of Jennings<sup>1</sup> however this approach seems unnecessarily complicated for repair of a small indirect inguinal hernia.

#### *B Reconstruction of the posterior inguinal wall*

1. Large indirect inguinal hernia.—When the abdominal inguinal ring is dilated to exceed a diameter of 2 centimeters and in encroaching upon the posterior inguinal wall is narrowing Hesselbach's triangle (Figs. 3a and 3b) the entire posterior wall should be reconstructed. The first step in the procedure is dissection of the sac. Duplicating the procedure employed in the operation for the small indirect variety exploration is made through the sac then after a high ligation the sac is excised. If a direct hernia or a femoral hernia exist together or if the three are present, they are to be converted into one sac by the so called Hougat maneuver. Two incisions are then made through the posterior wall (Fig. 3b at 1 and 2). The first incision is made in the rectus sheath just lateral to the point of fusion of the external oblique aponeurosis to the sheath and extends from pubic crest superiorly for a distance of 3 or 4 centimeters (Figs. 3b and 3c). This is the relaxing incision<sup>2</sup> which allows the sheath to slide laterally and inferiorly when the repair is completed. It further permits suture to the superior pubic ligament without tension. The remaining defect is protected by the rectus abdominis muscle and its tendon of origin. The second incision begins at the abdominal inguinal ring and extends medially and inferiorly to the superior pubic ligament. In completion of the latter incision all attenuated fascia and aponeurotic fibers from the posterior inguinal wall are excised (Figs. 3b and 3c). Redundant portions of the fascia of the spermatic cord and of the cremaster muscle hypertrophied

<sup>1</sup>Jennings, Anson, and Wright (1913)

<sup>2</sup>Allen, J. B., Rosenfeld, 240; McVay and Anson, 941; Tanner

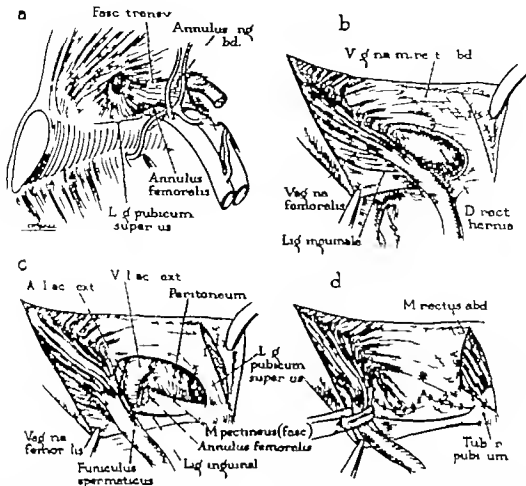


Fig 4. a, The inguinal region posterior view. Simulating a case of direct inguinal hernia of pedunculated type. Peritoneum, retroperitoneal connective tissue, and the hernial sac have been removed to demonstrate the aponeuroticofascial defect. The defect affects the inguinal wall in direct course. The abdominal inguinal ring is normal in size and the inferior epigastric vessels are not displaced (in contrast see Fig 3a). The femoral ring is normal in caliber and position and the insertion of the transversus layer into the superior pubic ligament is normal in breadth. b, The same specimen anterior view. Showing the bulge in the inguinal wall. The spermatic cord contains no processus vaginalis. It is retracted inferiorly and laterally to demonstrate the size of the hernial sac. As in the procedures hereinbefore described and figured, the inguinal ligament is retracted inferiorly to demonstrate the femoral sheath. The first incision (at dotted line 1) is the relaxing incision in the rectus sheath made just lateral to the line of fusion of the external oblique and internal oblique aponeuroses. The second incision (at dotted line 2) follows the upper margin of the attenuated posterior wall, and is the superior boundary of that portion which is to be excised. c, Continuing the procedure the relaxing incision (at 1) has

been made, and through its slightly retracted borders the underlying rectus muscle can be seen. The succeeding incision (at 2) has also been made additionally all of the attenuated portion of the inguinal wall has been excised to expose the superior pubic ligament and the margin of the femoral sheath. The excision of aponeurotic fibers and fascia extends to the abdominal inguinal ring. The hernial sac has been removed, the spermatic cord retracted farther lateralward. The posterior inguinal wall along its newly made margin will be sutured to the superior pubic ligament and to the femoral sheath (along dotted lines). d, Concluding the surgical steps, the strong superior and medial portion of the transversus layer has now been drawn downward and sutured to the superior pubic ligament (at 1) and to the anterior femoral sheath (at 3). The spermatic cord has been pulled even farther lateralward (at 4) to demonstrate that the suture line extends far enough laterally to close snugly the abdominal inguinal ring. The defect produced at the relaxing incision (at 1) by the sliding inferolateralward of the transversus layer is again demonstrated (compare Fig 3d). As before, the spermatic cord is replaced against the newly made posterior wall and the external oblique aponeurosis is closed over it.

through the presence of the large contained hernia are likewise excised (compare Figs 3b and 3c). The inguinal ligament is freed by blunt dissection and retracted inferiorly to expose the femoral sheath and the fascia of the pectineus muscle (Fig 3c). Shreds of attenuated transversus layer (posterior inguinal wall)

are trimmed from the superior pubic ligament the preperitoneal connective tissue and fat are pushed inward to expose the superior pubic ligament throughout its length similarly the femoral vein and the margin of the anterior layer of the femoral sheath are exposed—and especially that part of the sheath where the

retched fascia was excised. The troublesome preperitoneal fat and areolar tissue may be kept out of the field merely by pressure with small gauze pack, held with a small ribbon tractor which is to be introduced from the lateral side.

Sutures are then placed for the closure, beginning medially at the pubic tubercle and extending as far lateralward as the femoral vein. Each suture should include the transversus abdominis and fused transversalis fascia above and the superior pubic ligament below. They are to be placed about 2 millimeters apart. These sutures are not tied until two additional sutures are placed. After the last suture is placed in the superior pubic ligament close to the femoral vein, the next suture includes the same layer above but below it passes deeply into the pectineus fascia (where the leader from the label *Annulus femoralis* touches the femoral ring in Fig. 3c). The next suture includes transversalis fascia superiorly, which point the layer is usually muscular below. It includes the anterior layer of the femoral sheath at the latter's medial extremity. Returning to the first suture placed near the pubic tubercle, the operator ties them in the order in which they were placed. At this point the pack and the retractor are removed from the preperitoneal space, and the remainder of the closure is accomplished by approximating the transversalis fascia to the anterior layer of the femoral sheath far enough lateralward to make a snug abdominal inguinal ring (Fig. 3d). The new abdominal inguinal ring is usually 1 to 1.5 centimeters lateral to the normal position of the ring over the femoral vein. Thus the new ring is either directly over the femoral artery or slightly lateral thereto (Fig. 3d). The relaxing incision has converted an original slit into a triangular defect (compare Figs. 3b, 3c, and 3d). If the underlying rectus abdominis is indurated, the retracted lateral margin of the defect may profitably be sutured to it with interrupted fine silk sutures (Fig. 3d) however, if it is fleshy, suturing is either omitted or the lateral retracted edge is sutured to overlying external oblique aponeurosis.

The presence of the artificial defect need occasion no uneasiness. If its lateral margin is

lifted and exploration carried a few millimeters farther lateralward, the transversalis fascia will be found to invest the rectus muscle as the rectus fascia (McVay and Anson 1940). This layer effectively prevents the preperitoneal layer from protruding through the defect in the rectus sheath. Thus the strong remaining portion of the posterior inguinal wall and part of the rectus sheath are moved laterally and inferiorly to a new position and are sutured without tension to form a new posterior wall that becomes the supportive equivalent of the normal parietes. Since no additional reparative measures are necessary, the cord is dropped back into normal position and the external oblique aponeurosis is closed over it to produce a snug subcutaneous inguinal ring. This maneuver restores the normal obliquity of the inguinal canal and also fills up a trihedral space made by the repair. This potential dead space exists because the new posterior wall does not possess redundancy inferiorly equal to that of the normal undisturbed, inguinal wall. Ambulation and intra abdominal pressure should early produce the normal redundancy.

2. The direct inguinal hernia.—In this type of hernia the defect is one of direct course through the abdominal wall (Fig. 4a). Although it may be associated with one or the other or with both of the two other types of groin hernia, only the direct variety need be considered. The fundamental problem remains unaltered by the concurrent presence of the other parietal defects.

All surgeons are familiar with the different types of direct inguinal hernia, from the pedunculated variety that may strangulate to those exhibiting expansive bulging of the entire wall in which the neck of the sac is as broad as any other portion. It is often difficult to decide whether the wall is merely lax (as it frequently is in asthenic individuals) or whether a direct hernia exists. While it is not the province of this paper to consider this problem, it would not be amiss to say that if the bulge is symptomless, it is wise not to intervene—especially if the patient is in the old-age group.

Exposure, elevation of the spermatic cord and examination of the cord for the presence

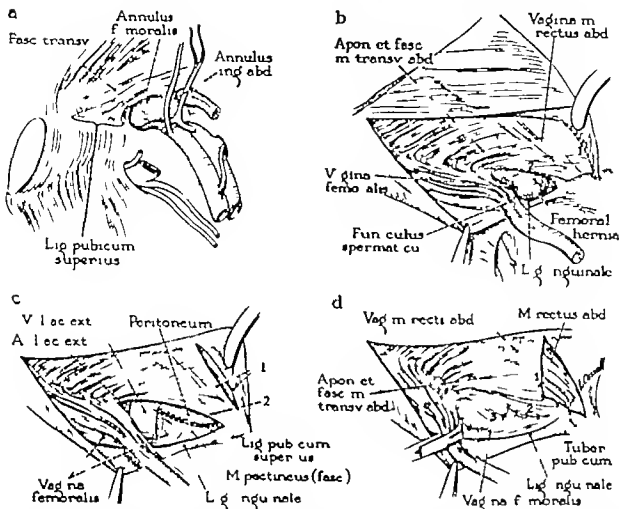


Fig. 5 a, The inguofemoral region, posterior view simulating a case of femoral hernia. As in the preceding steps of dissections, serous and subserous layers and the hernial sac have been removed to demonstrate the defect in the aponeuroticofascial portion of the transversus. The defect is an enlarged femoral ring. The dilated ring encroaches upon the inguinal wall from the inferolateral aspect, with resultant decrease in the breadth of insertion of the transversus layer into the superior pubic ligament. There is no defect directly through the lower abdominal wall, such as occurs in direct inguinal hernia. Furthermore, the abdominal inguinal ring is not dilated as it is in cases of indirect inguinal hernia. b, The same specimen seen from anterior view. The spermatic cord, retracted inferolaterally, contains no processus vaginalis. The bulge is seemingly inguinal in position; this appearance is the result of displacement, downward, of the inguinal ligament to expose the hernia in the femoral canal. Just medial to the bulge in the femoral canal the recess (shaded) represents the more posterior course of descent of the normal inguinal wall to the lateral part of the superior pubic ligament. The relaxing incision (dotted line at 1) and the incision in the posterior wall (dotted line at 2) are, generally, the same as those employed in the previously described conditions. The second incision permits access to the real defect, namely, a femoral ring dilated through narrowing of the insertion of the transversus layer into the superior pubic ligament. However, in this instance, the second incision (at 2) is close to the ligament for maximum preservation of the intact transversus layer (posterior inguinal wall). c, Con-

tinuing the steps in the technique the relaxing incision (at 1) has been made (as in Figs. 3c and 4c). The second incision (at 2) has been completed, to expose the superior pubic ligament and the margin of the femoral sheath. The hernial sac has been excised, the enlarged femoral ring exposed. The suture-line (dotted in figure) along the superior pubic ligament, extends to the femoral vein and will obliterate the femoral ring. A similar method is employed in the repair of direct inguinal and large indirect inguinal hernia (Figs. 4c and 3c, respectively). Whereas in the two preceding types of hernia, the first part of the suturing at the femoral sheath follows the margin of the femoral ring, in the present instance the first suture is made into the pectineus fascia lateral to the dilated medial margin of the femoral ring. The defect to be repaired is smaller than in the two preceding instances (compare Figs. 3c and 4c). d, Concluding the reparative steps, the procedure duplicates that in either of the two preceding instances (Figs. 3d and 4d). Sutures (at 1) bring the lateral retracted margin of the relaxing incision into contact with the underlying rectus tendon. Other sutures (at 2) bring the transversus layer downward to the superior pubic ligament. The final sutures (at 3) fasten the transversus layer to the anterior layer of the femoral sheath. The last suture (shown by retracting the spermatic cord) extends into and closes the abdominal inguinal ring. The repair of the femoral hernia having been accomplished, the spermatic cord is dropped against the posterior wall, back into the normal position, and the external oblique aponeurosis is closed over it.

of an associated indirect sac are carried out in the manner previously described. In the penduculated direct inguinal hernia with a small rigid neck the hernia may pass not only through the subcutaneous inguinal ring but may even become scrotal—contrary to the usual statement that a direct inguinal hernia never descends to scrotal level. The incisions are made in this type of hernia exactly as in the preceding instance (figs. 4b and 4c). Usually the second incision is more superiorly placed than in the large indirect variety since more of the posterior inguinal wall is attenuated in a direct hernia of the diffuse type (fig. 4b). All of the thinned aponeuroticofascial layers are excised; the superior pubic ligament and the anterior layer of the femoral sheath are identified (fig. 4c). The second incision extends upward into the abdominal inguinal ring. The base of the cord is again examined for an indirect hernial sac.

Further handling of the direct hernial sac depends upon its size and character. All penduculated sacs are opened and examined for incarcerated or adherent viscera. The neck is closed in the usual manner and the sac excised. This type of sac if reduced without being opened and excised can result in an internal type of hernia without visible or palpable external evidence. The small diffuse type of sac need not be opened but all large diffuse sacs should be. Excess peritoneum is cut away and the serous wall then closed in a linear fashion—repair thus being easier because there is less tissue to be depressed out of the operative field.

Repair is then carried out by steps exactly duplicating those outlined under the repair of the large indirect hernia. The transversus layer is approximated to the superior pubic ligament and the anterior layer of the femoral sheath (fig. 4d); the cord is restored to normal position and the external oblique aponeurosis closed over it. An additional note is pertinent concerning the defect in the rectus sheath resulting from the relaxing incision (fig. 4d). Although the defect is usually larger than in the preceding instance no case was encountered in which the direct hernia was too large to be repaired by this method or in which aponeuroticofascial transplants were required.

3. The femoral hernia.—In this type of hernia, whether congenital or acquired, the defect is associated with a narrowing of the insertion of the transversus layer into the superior pubic ligament (compare insertion fig. 2a with narrowed insertion fig. 5a). The exposure, the elevation of the spermatic cord and careful examination of the cord for possible occurrence of an indirect sac are carried out as previously outlined in the discussion of large indirect inguinal hernia. If the inguinal ligament is freed and retracted inferiorly much of the hernial bulge is exposed above the inguinal ligament (fig. 5b). The incision in the transversus layer is made as close to the superior pubic ligament as possible (figs. 5b and 5c). In the authors experience strong posterior inguinal walls were found in cases of femoral hernia a circumstance which permits the low incision. Over the femoral vessels the incision is made just below the termination of the transversus muscle where the transversalis fascia becomes the anterior portion of the femoral sheath.<sup>1</sup> This incision is carried lateralward into the abdominal inguinal ring (fig. 5c). Again the base of the cord is examined for a small indirect sac. The femoral sac is pulled into the position of a direct inguinal hernial sac (fig. 5b) with cutting of the inguinal ligament if necessary. Then the sac is opened and after exploration of content it is ligated and excised. The repair then follows the plan set forth in the descriptions of the two preceding types (note similarity in figs. 3c, 4c, and 5c and 3d, 4d and 5d). The relaxing incision is employed (figs. 5c and 5d). Usually the defect produced over the rectus muscle is

<sup>1</sup> The femoral rim is easily exposed. It should be seen in every case to avoid entangled nature of the needle. Certain smaller vessels, however, can cause the surgeon considerable difficulty. Exposure of the superior pubic ligament, small artery and vein are usually encountered, running medially along the lumbar-external road. The pyramidalis, if troublesome, they should be doubly ligated and cut. The possible occurrence of anomalous obturator vessels should also be kept in mind. Veins in the preperitoneal fat are easily injured; occasionally they are missing, especially in the area adjacent to the bladder. The freeing of the femoral sheath is followed by vessels are encountered immediately beneath the fascia, the origins of the inferior epigastric, the deep iliac circumflex and the external spermatic vessels. In the majority of cases, the external spermatic vessels do not pass through the abdominal inguinal ring but gain access to the fasciae of the cord through separate apertures just medial to the abdominal inguinal ring. If the latter vessel hinders the making of a tight closure of the abdominal inguinal ring, they should be ligated and cut.

smaller since the only compromise in the posterior wall is the redundancy produced by the slight overlapping at the suture line along the superior pubic ligament and the anterior layer of the femoral sheath. The spermatic cord is dropped back into normal position and the external oblique aponeurosis closed over it.

## SUMMARY

A single operative procedure is presented for the repair of large indirect inguinal, direct inguinal and femoral hernias. This operation consists essentially of restoring inguino-femoral anatomy to normal status. Repair is similar because the three types of hernias represent defects in the same layer at different points.

Since there is no anatomic defect in the inguino-femoral region in the uncomplicated small indirect inguinal hernia other than the presence of a congenital hernial sac and a slight dilatation of the abdominal inguinal ring, it is recommended that this type of hernia be repaired by removal of the sac by accepted methods and by subsequent tightening of the abdominal inguinal ring.

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# EFFECTIVENESS OF DICUMAROL PROPHYLAXIS AGAINST THROMBOEMBOLIC COMPLICATIONS FOLLOWING MAJOR SURGERY

A Four Year Survey 3 304 Cases

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THE underlying causes of thrombosis and embolism and their prevention have in recent years received much consideration. Two opposing schools of thought have arisen: (1) those who advocate chemotherapeutic measures with anti-coagulants (3, 4, 8, 9, 20, 24, 25) prophylactically and therapeutically employed; and (2) those who advocate surgical intervention, i.e., venous ligation (1, 2, 17) prophylactically and therapeutically. The reports of the effectiveness of early ambulation are still contradictory. A recent investigation (39) reveals that the incidence of thrombosis postoperatively is not appreciably affected, but the mortality rate from pulmonary embolism was reduced to one half.

The approach that has shown the greatest promise has been chemotherapy with the anti-coagulants dicumarol and heparin. Intensive studies with favorable results are appearing in increasing volume from various clinics in this country (3) and abroad, e.g., Scandinavia (9, 50).

It was our purpose to investigate on a long term basis whether it is possible to find any reduction in the frequency of thromboembolic disease with an accompanying decrease in the number of fatal pulmonary embolisms. Chemoprophylaxis with dicumarol together with other measures as indicated were used in a routine program in unselected cases of major abdominal and pelvic procedures. Surgery has reached the stage where, in many types, particularly in elective surgery, we are work-

ing for an improvement in mortality in fractions of 1 per cent. The prophylactic therapy must not create additional hazards to the patient, otherwise it defeats its purpose.

Dicumarol has been used in our work because it can be administered by mouth, has been found by us to be easier to regulate than heparin, and it is far less expensive. When a rapid alteration of the blood clotting mechanism is desired, it is necessary to use heparin by means of which an immediate effect may be obtained. But this anticoagulant is too expensive for routine application, and economics play an important role in any clinical project.

The incidence of venous thrombosis, diagnosed clinically in postoperative cases, ranges between 1 and 10 per cent (5, 21). The actual incidence of postoperative thrombosis is not known, nor is the frequency of pulmonary embolism known. Data about fatal embolism are more certain. Pulmonary embolism is the cause of about 5 per cent of all postoperative deaths when all the figures throughout the country are considered. The incidence rate or death rate is probably lower now than it was some years ago, due to a better understanding of the pathology and treatment, but our data do not show a significant difference. It is now so low that some investigators, namely Lam and Hooker, question whether all the effort that would have to be made to reduce the mortality by the use of anticoagulants, with their added dangers, justifies their use.

Some surgeons are advocating and practicing ligation (17) of part of the venous return system from the lower extremities, therapeutically and as a prophylactic. It seems to be justifiable to attempt to find some less radical procedure than ligation of the femoral vein.

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the external iliac vein, or vena cava. There are many reasons for trying to find a medical rather than a surgical prophylactic. Some advocates of prophylactic ligation are now recommending ligation of both femorals in all patients who are to undergo major surgical procedures or to be bed confined for any length of time or who are over 50 years of age. When one thinks of the number of operations that are done on individuals of this age, and that this number will be increasing with the increased longevity and greater security in surgery it makes a rather appalling picture to think that each of these may have to have two additional operations. Furthermore, ligation of the femorals does not always block the vein above the source of danger, as in pelvic and abdominal surgery the embolus may originate in the pelvic vessels or in the deep femoral when the superficial femoral was ligated. Furthermore, such ligations are not without their morbidity and mortality.

McCartney has shown that at autopsy of 4,070 postoperative deaths, 11.5 per cent manifested thromboembolism, and for 5.3 per cent pulmonary embolism was thought to be the cause of death. An effort is being made to show that the possibility of thromboembolism is present in 10 or more per cent of patients with an increase of 25 to 50 per cent in adults and older patients operated upon or bed confined. These findings emphasize the importance of some type of prophylaxis which must follow one or all three conditions conducive to thrombotic complications: i.e. (1) slowing of the blood stream, (2) endothelial damage, and (3) enhanced coagulability of blood (21). Too little has been said about the excessive use of sedatives and narcotics preoperatively and postoperatively producing long hours of quiet, which diminishes respiratory excursion and probably in other ways slows the circulation.

Numerous procedures (21) have been proposed to offset factors resulting in thromboembolism. Many of these measures have supposedly been shown by statistical studies, of ten of doubtful significance, to lower the incidence of thrombosis and embolism.

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Reference has been made to the occurrence of thromboembolism in patients confined to bed for a long period but it has not been sufficiently emphasized that it is not by any means limited to surgical patients. Many cases are seen on the medical service (16, 28, 31). The efficacious use of dicumarol in coronary thrombosis for the prevention of thromboembolism a frequent complication in this clinical category, has now been confirmed (32, 36, 37, 49).

As already stated, if the figures quoted above are anywhere nearly true, it seems justifiable to try to find some procedure much less radical than vein ligation and more suitable for common usage. The anticoagulants specifically dicumarol appear to offer a satisfactory approach if expertly used and meticulous care is exercised. *However one must bear in mind that the use of an "induced controlled hemorrhagic state" to combat a transitory physiological clotting tendency is potentially hazardous by its very nature.*

An important phase of chemoprophylaxis is that it inhibits further thrombosis throughout the body (3, 12) while venous ligation is local in its sphere of influence.

#### CLINICAL MATERIAL

The routine prophylaxis program at Mercy Hospital in actual practice includes all types of surgery but for purposes of presentation and discussion the category where greatest predisposition to thromboembolic complication appears namely major pelvic and abdominal surgery or combinations has been selected. The major operations included in this investigation are as follows: (1) all types of hernioplasty and combinations, cholecystectomy with and without exploration of the common duct, (2) hysterectomy and gynecological abdominopelvic surgery, (3) appendectomy for varying degrees of severity of appen-



# EFFECTIVENESS OF DICUMAROL PROPHYLAXIS AGAINST THROMBOEMBOLIC COMPLICATIONS FOLLOWING MAJOR SURGERY

## A Four Year Survey 3 304 Cases

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THE underlying causes of thrombosis and embolism and their prevention have in recent years received much consideration. Two opposing schools of thought have arisen. (1) those who advocate chemotherapeutic measures with anti-coagulants (3, 4, 8, 9, 20, 24, 25) prophylactically and therapeutically employed and (2) those who advocate surgical intervention i.e. venous ligation (1, 2, 17) prophylactically and therapeutically. The reports of the effectiveness of early ambulation are still contradictory. A recent investigation (39) reveals that the incidence of thrombosis postoperatively is not appreciably affected, but the mortality rate from pulmonary embolism was reduced to one half.

The approach that has shown the greatest promise has been chemotherapy with the anti-coagulants, dicumarol and heparin. Intensive studies with favorable results are appearing in increasing volume from various clinics in this country (3) and abroad e.g. Scandinavia (9, 50).

It was our purpose to investigate on a long term basis whether it is possible to find any reduction in the frequency of thromboembolic disease with an accompanying decrease in the number of fatal pulmonary embolisms. Chemoprophylaxis with dicumarol together with other measures as indicated were used in a routine program in unselected cases of major abdominal and pelvic procedures. Surgery has reached the stage where in many types, particularly in elective surgery we are work-

ing for an improvement in mortality in fractions of 1 per cent. The prophylactic therapy must not create additional hazards to the patient otherwise it defeats its purpose.

Dicumarol has been used in our work because it can be administered by mouth has been found by us to be easier to regulate than heparin and it is far less expensive. When a rapid alteration of the blood clotting mechanism is desired, it is necessary to use heparin by means of which an immediate effect may be obtained. But this anticoagulant is too expensive for routine application and economics play an important role in any clinical project.

The incidence of venous thrombosis, diagnosed clinically in postoperative cases, ranges between 1 and 10 per cent (5, 21). The actual incidence of postoperative thrombosis is not known nor is the frequency of pulmonary embolism known. Data about fatal embolism are more certain. Pulmonary embolism is the cause of about 5 per cent of all postoperative deaths when all the figures throughout the country are considered. The incidence rate or death rate is probably lower now than it was some years ago due to a better understanding of the pathology and treatment, but our data do not show a significant difference. It is now so low that some investigators, namely Lam and Hooker question whether all the effort that would have to be made to reduce the mortality by the use of anticoagulants, with their added dangers justifies their use.

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TABLE I.—COMPARISON OF INCIDENCE OF THROMBOEMBOLIC COMPLICATIONS AND DEATHS IN DICUMAROLIZED AND NONDICUMAROLIZED PATIENTS

Year	Total	U treated	Treated	Total			Untreated			Treated		
				Complications	Embolic phenomena	Deaths	Complications	Embolic phenomena	Deaths	Complications	Embolic phenomena	Deaths
1938	1,073	1,073	None			7			7			
1939	87	87	None									
1940	179	179	None									
91	2	2	None	5	5		5	5				
1942	2,2	2,2	None									
93	79	79	None		5			5				
Total	1,360	7,360		57	20	8	57	20	8			
1944		34	179				2	5				
94		7	000									
1945	1,14	405	053									
94	1,11		1,098									( ) <sup>20</sup>
Total	2,22	479	2,104			6		8				( ) <sup>20</sup>
Grand Total	154	6,154	2,104	84	26	14	72	28	14	4		( ) <sup>20</sup>

\*Owing to liver damage, extensive carcinoma, and other multiple complications, death probably not due to embolism.

dicus (4) various types of genitourinary tract surgery (5) colonic and abdominoperineal resections. Thoracic procedures, radical mastectomies and operations on extremities for recent and old fractures, although receiving the anticoagulants for prophylaxis, were not included because of insufficient numbers in these categories compared to those selected. The clinical diagnosis of thrombosis and embolism was established by the classical symptoms and signs. Patients with transitory signs have been included. Suspected cases of pulmonary embolism accompanied by sudden pain in the chest followed by fever of several days duration were examined by roentgenography. Postmortem examination of a number of cases confirmed the clinical findings.

The numbers for the period 1944-1947 appear themselves sufficient for comparison and formulation of at least tentative conclusions (Table I). This survey also includes data for 6 preceding years (1938-1943) during which anticoagulants were not used. Previous investigations have shown that large numbers of patients are required in statistical studies of methods of prophylaxis. Also it is necessary to eliminate cyclic variations in incidence. It must be quickly said however that perhaps

some may think larger numbers are desirable as well as a longer period of years of study before any definite conclusion can be drawn.

Postoperative cases were selected for dicumarolization where there was no obvious hazard of hemorrhage. The vast majority are consecutive. The patients not treated were those on the private services of the visiting staff who were not favorably disposed toward a routine prophylactic anticoagulation program. These patients made up the control or untreated group. Also a small group of patients were not treated prophylactically for the following reasons. The clotting mechanism of the blood was already shifted in favor of bleeding as shown by routine prothrombin clotting time determinations which were above normal throughout hospitalization. It was our impression that these patients were not subject to thromboembolic complications, and none were encountered in this group. They were excluded from the untreated and treated series. The general age range was from the second decade to the eighth. Patients younger than 20 years of age have been excluded in this survey. The numbers of untreated and treated patients by years are presented in Table I.

## METHODS

Dicumarol (23) has been administered orally to 3,304 patients in the prophylactic program reviewed in this paper. The initial dosage of the drug was 200 milligrams administered on the second postoperative day. Subsequent doses were given on alternate days to maintain a relative prothrombin activity level of not under 40 per cent of normal. Dicumarolization was continued throughout the hospitalization period and discontinued when the patient was discharged. The average total consumption was 600 to 800 milligrams.

The generally accepted contraindications to the use of dicumarol (3) are (1) the presence of definite renal insufficiency (2) the presence of definite hepatic insufficiency or hepatogenous jaundice particularly if associated with decrease in prothrombin activity (3) subacute bacterial endocarditis (4) purpura of any type (5) blood dyscrasia with tendency to bleed and (6) recent operation on the brain or spinal cord. Dicumarol should be given cautiously (3) to patients who have (1) ulcerative lesions open wounds or potentially bleeding surfaces (2) vomiting due to gastric or intestinal drainage or (3) dietary or nutritional deficiency. If an operation is contemplated ample time should elapse for the return of prothrombin activity to near normal if dicumarol is administered before the operation. If an emergency surgical procedure is necessary on the patient who has decreased prothrombin activity owing to dicumarol large doses of synthetic vitamin K derivative (72 milligrams hylkanone) should be given intravenously to combat the reduced activity of blood clotting components before the operation is begun (11, 45).

For success of the prophylactic program with the anticoagulant dicumarol it is essential to have a centralized control of the drug and a laboratory which insures execution of a unified pattern—a specialized team to carry on anticoagulant therapy by means of rigidly standardized procedures. Such a pattern is conducive to efficiency and fixing of responsibility. The Mayo Clinic is an example of this type of discipline (6, 18).

In the administration and control of the anticoagulant dicumarol a sensitive repro-

ducible and standardized procedure for the estimation of an induced decrease in prothrombin activity is positively essential to insure uniformity and comparability of laboratory data. During the course of this investigation we have expended much effort to establish such a procedure (6). Barker (18) of the Mayo Clinic has likewise emphasized this precaution if reproducible and predictable response to dicumarol is to be obtained. A modified single stage prothrombin clotting time procedure developed by us has been used routinely. It is most unfortunate that the prothrombin clotting time techniques in different parts of the country are not uniformly standardized since much confusion exists with regard to interpolability of accumulated data. Efforts are being directed to establish a standard procedure by a national committee<sup>1</sup> and conference<sup>2</sup>.

The anticoagulant effect of dicumarol can be detected only by a prolongation of the prothrombin clotting time of plasma (23). In our laboratory a modification of the original Quick method (40) was developed which shows a higher degree of sensitivity to variations in prothrombin activity and dependable reproducibility. Such reproducibility must be possible with normal plasma and plasmas during varying degrees of the dicumarol effect. The only means of standardization has been saline dilution of normal plasma to approximate the prothrombin clotting time values obtained during the administration of dicumarol. Standardization of this procedure has been beset with almost unsurmountable technical difficulties. A number of other described procedures (26, 35, 38, 44) have been tried but were not very satisfactory. The two stage method (47) was not adaptable for large numbers of daily routine determinations.

As previously reported (7, 46) the prothrombin clotting time of saline diluted plasma could be used to determine a tendency toward hyper-coagulability of plasma (7, 13, 33, 44, 48). Two prothrombin clotting time determinations have been made routinely on

<sup>1</sup> American Heart Association Committee on the Use of Anticoagulants in the Treatment of Coronary Thromboses with Myocardial Infarction. Irving S. Wright, chairman.

<sup>2</sup> Josiah Macy Jr. Foundation Conference on Blood Clotting and Allied Problems, January 1948.

all patients, namely on undiluted plasma and saline diluted plasma (12.5%). This procedure has proved very satisfactory as demonstrated by the results presented in this paper.

It was decided that the prothrombin clotting time of saline diluted plasma (12.5%) on the second postoperative day would determine whether or not prophylaxis was indicated. If this value was 70 seconds or lower the patient was given dicumarol prophylactically. With very few exceptions (less than 0.05 per cent of all treated cases) this plan was satisfactory. To wait longer than the second day to see if the prothrombin time of diluted plasma will start to rise is to invite thrombotic complications. The prothrombin clotting time of diluted plasma taken preoperatively or on the day of operation is unreliable because of the unpredictable physiological increase in activity of the blood clotting elements after the trauma of operation.

The clinical results herein reported have been obtained with conservative dicumarolization that is, decreasing the prothrombin activity to about 40 per cent of normal and maintaining it during the hospitalization period. Other workers (3) notably the Mayo Clinic and Scandinavian investigators (9, 50) recommended that plasma prothrombin activity be maintained at 10 per cent or 20 per cent of normal. Further study and accumulation of evidence will reveal which level is more efficacious. Drastic or radical dicumarolization does not completely eliminate thromboembolic complications (Scandinavian work and Mayo Clinic—3, 9, 50) but does increase the risk of bleeding and incidence of hemorrhagic complications. Fatalities have been reported ascribable to dicumarol effects (10, 14, 42).

Fibrinogen determinations were made in a large number of cases in the present series to ascertain if liver toxicity to dicumarol could be demonstrated. The methods developed by Morrison were used. Analyses were made on alternate days during the hospitalization period.

#### RESULTS

A survey of Mercy Hospital clinical records for the period 1938 through 1947 is tabulated according to years with respect to number of

cases, total thromboembolic complications, embolic phenomena and deaths (Table I). It is possible to compare the distribution of such complications for a period of 6 years, without anticoagulants prophylactically used with a 4 year period during which the routine anticoagulant program was in operation. In this period in about 61 per cent of the major abdominopelvic surgical cases patients received dicumarol prophylactically. The vascular complications consisted of the classical types, namely thrombosis of the leg or pelvic veins, and pulmonary infarction with single or multiple embolic manifestations.

For the 4 year period (1944-1947) under investigation, there was a total of 5,334 major abdominopelvic operations. There were 2,030 patients untreated with 21 thromboembolic complications (1%) 8 embolic complications (0.4 of 1%) and 5 deaths from pulmonary embolism (0.2 of 1%). In summary there were 34 of the 2,030 untreated patients with vascular complications (1.6%).

There were 3,304 patients treated prophylactically with dicumarol with 4 thromboembolic complications (0.1 of 1%) as compared to 1% of the untreated) pulmonary infarction (0.03 of 1% as compared to 0.4 of 1% of the untreated) and 1 death (0.03 as compared to 0.2 of 1% of the untreated) probably not actually due to pulmonary embolism. In summary there were 6 of the 3,304 treated patients with vascular complications (0.18 of 1% as compared to 1.6% of the untreated).

A comparison with the years 1938-1943 reveals that in this period there were 7,220 untreated patients with 57 thromboembolic complications (0.8 of 1% as compared to 1% for 1944-1947) 20 embolic phenomena (0.3 of 1% as compared to 0.4 of 1% for 1944-1947) and 8 deaths from pulmonary embolism (0.1 of 1% as compared to 0.2 of 1% for 1944-1947) (Table I). In summary for 1938-1943 of the 7,220 untreated patients there were 85 patients with vascular complications (1% as compared to 1.6% for 1944-1947).

For the 10 year period 1938-1947 of 13,554 patients, 9,250 were untreated and 3,304 treated. There were 78 of the untreated (0.8 of 1%) with thromboembolic complications. There were 28 of the untreated (0.3 of 1%)

TABLE II.—CRITICAL RATIOS (C.R.) OF THE DIFFERENCE BETWEEN THE PERCENTAGES OF TREATED AND UNTREATED PATIENTS SHOWING COMPLICATIONS

Complications	1944-1947			1938-1947			U treated		
	Untreated N=2,030	Treated N=3,304	C.R.	Untreated N=6,250	Treated N=3,304	C.R.	1938-1943 N=730	1944-1947 N=230	C.R.
Thromboembolic	0.0344	0.0181	3.9	0.0543	0.008	6.4	0.07804	1.44	0.09
Embolic	0.0340	0.00308	8.6	0.0307	0.000308	4.8	0.03770	0.003040	77
Embolic deaths	0.02463	0.000302	9	0.01405	0.00030	8.2	0.00008	0.001463	.8
Total	0.05748	0.0085	4.8	0.0864	0.0085	8.8	.77	0.06748	.6

with embolic complications and 1 of the treated (0.03 of 1%) with embolic complications. There were 13 deaths from pulmonary embolism among the untreated (0.03 of 1%) and 1 death (probably not due to pulmonary embolism) (0.03 of 1%) among the treated. In summary there were 119 cases of vascular complications among the 9,250 untreated (1.2%) and 6 cases of vascular complications among the 3,304 treated (0.18 of 1%).

The critical ratios derived from a statistical analysis (prepared by the Reverend Henry Burke S.S. of Saint Mary's Seminary) indicate certain of the differences between the percentages to be significant (Table II). Statistically it can be shown that with a critical ratio of 2.58 the odds are 100 to 1 against an obtained difference being due to chance or random errors in sampling. But the critical ratios of 3.9, 4.2, 4.8, 6.4, and 8.2 indicate beyond a reasonable doubt the superiority of treatment to nontreatment with dicumarol as employed by us for the reduction of postoperative vascular complications. By our data it is also statistically shown to be probable, but not certain that dicumarol therapy as used during the course of this investigation is superior to nontreatment in reducing deaths from postoperative pulmonary embolism. There is no evidence that untreated patients during the period 1944-1947 fared any better in avoiding postoperative vascular complications than similar patients did between the years 1938-1943.

The data obtained may also serve as a basic reference in establishing a preprophylactic treatment incidence of vascular disorders on the combined surgical services at Mercy Hospital. A comparison is made between a period of 4 years when dicumarol was not used with

a 4 year span at which time the prophylactic program was in operation.

Patients receiving dicumarol totalling 3,304 compared with 2,030 not getting such therapy during the same period by comparison reveal a significant reduction in vascular complications.

A review of the surgical procedures in our prophylaxis series where the expectancy rate is fairly well established and is the highest reveals the following: There were 325 cases of hysterectomy with 2 instances of mild venous thrombosis and no embolic manifestations. These cases might be considered failures of conservative anticoagulation. There were 423 cases of hernioplasty with no thromboembolic complications. In the untreated group the expected incidence of thrombosis and embolism was encountered in this category. A number of untreated patients manifested no clinical signs of peripheral occlusion but suddenly terminated fatally from embolism.

Dicumarol has been administered to over 5,500 miscellaneous patients (confined and ambulatory) in periods varying from 10 days to 3 years. Of the 3,304 patients in the prophylactic program reviewed in this paper the incidence of major bleeding requiring blood transfusions is less than 0.1 of 1 per cent (Table III), and minor bleeding controllable with massive intravenous dosage of synthetic vitamin K derivative (hydroquinone) is about 2 per cent. The explanation for this low percentage of bleeding hazard may possibly be found in the

TABLE III.—HEMORRHAGIC INCIDENCE FOLLOWING DICUMAROLIZATION

Number of cases major abdominal pelvic surgery	3,304
Requiring blood transfusion	1
Minor bleeding	76
Deaths due to dicumarol	0

fact that conservative anticoagulation therapy was used and hyperreaction to the drug was readily detected. Bleeding has not been a cause of great concern.

Other side reactions such as gross hematuria, nausea, vomiting and diarrhea occurred to the extent of about 3 per cent. Minor purpuric manifestations were found in less than 1 per cent of the cases studied. Bleeding at the surgical site was noted in a few cases. In general, minimal untoward side reactions were encountered. No deaths ascribable to excessive dicumarol effect were encountered in the series of cases presented in this paper.

Fibrinogen concentration varied in postoperative patients according to the expected pattern and independently of the degree of dicumarolization. There was no evidence of liver toxicity (19) due to the drug in so far as this blood constituent was concerned. This finding is another argument in favor of conservative therapeutic use of the anticoagulant.

#### DISCUSSION

Granting the multiplicity of factors contributing to thromboembolic disease following major surgery, anticoagulation has offered what appears to be a satisfactory approach for decreasing the incidence of such complications. The choice of anticoagulant is governed by the facility and safety with which it can be used. In principle, an induced controlled hemorrhagic state (decreased coagulability of blood) to forestall a potential tendency to thrombosis has been employed. A delicate balance between bleeding and clotting has to be maintained. The findings herein reported indicate that conservative inhibition of the components of the blood coagulation system has yielded encouraging results.

However, it must be borne in mind that there are factors other than increased clotting tendency which may give rise to thromboembolism. It is not to be construed that controlled alteration of blood clotting components is entirely responsible for the results obtained. But it is of interest that a reduction in the incidence of thromboembolism is possible when this factor is considered particularly in the light of results obtained with other procedures, i.e., early ambulation and venous ligation.

The availability of these procedures makes possible a judicious selection of one, or appropriate combinations of them. It does seem that enhanced coagulability of the blood, or the ability to propagate existing clots is the primary factor. Checking this tendency chemotherapeutically satisfactorily forestalls the undesired effects whether there be a sluggish circulation or a pre-existing focus in the form of a small clot. Anticoagulation on this basis seems to be a more rational approach and appears to be substantiated by practical application.

To maintain a balance of the blood clotting components on the hemorrhagic side without deleterious effect on the patient requires delicate methods and a disciplined team. It is deplorable that coagulability of blood can be expressed only in crude relative terms rather than specific quantitative ones. The chemistry of the blood coagulation components and their mechanism is still in a chaotic and controversial state although definite progress (30, 34, 41) is being made steadily. In this direction, therefore, during the course of this investigation, laboratory control procedures including reagents had to be developed while lacking in desired precision yielded information which made anticoagulation reasonably safe in our hands. A competently disciplined team served as an indispensable adjunct. Also, our knowledge of the mechanism of action of the anticoagulants available (i.e., dicumarol and heparin) is meager and incomplete. The use of this procedure is fraught with a number of apparently insurmountable difficulties—a veritable primeval wilderness that needs to be carefully and systematically explored.

The clinical use of dicumarol is not without bleeding hazards (3, 9, 10). The most accepted thesis of the mechanism of dicumarol effect (21) is the inhibition of prothrombin production by the liver since it has been found that prothrombin activity decreases following oral administration of this drug. It is generally assumed that hemorrhagic manifestations—purpura and bleeding from surgical site—are directly correlated with the degree of depression of prothrombin activity. Experience reveals that in some instances these manifestations appear at levels of prothrombin activity

ity where they would not be expected. Fortunately the number of such occurrences is small. Therefore even conservative depression of prothrombin activity may show some minor bleeding manifestations. It falls out of the category of hyperreaction and possibly may be classified as sensitivity or idiosyncrasy of the coagulation system but associated with capillary weakness. Our election of a conservative pattern has resulted in an incidence of hemorrhage that is negligible. Such a procedure has the added advantages that such prothrombin activity levels are more readily maintained and it avoids the prolonged cumulative effect of the drug. Some clinics maintain that a drastic reduction in prothrombin activity is necessary to insure prophylaxis and that protection against thromboembolic complications is directly related to the degree of reduction in prothrombin activity. Due to the inadequacy of present methods and lack of standardization it is impossible to make a comparison of the effects of prothrombin depression carried at various levels in different clinics. It is also difficult if not impossible to compare prothrombin activity levels reported from various laboratories because of the heterogeneity of prothrombin estimation procedures in use.

To make the giving of dicumarol effective but above all to insure safety it must be realized that there is required a laboratory setup of specialized type with specifically trained and skilled technical workers. Moreover it is impossible to cause therapeutic depressions of a patient's prothrombin activity by dicumarol at a consistent level and without danger of hemorrhage unless prothrombin testing is done with a thromboplastic reagent which is adequately sensitive and which will constantly and consistently give reproducible values in a series of saline dilution of normal plasma. The effort necessary to surmount these difficulties raises the question of the advisability to pursue such a course of prophylaxis to reduce an already relatively small incidence of fatal and nonfatal thromboembolic complications.

#### CONCLUSIONS

1. The foregoing data reveal beyond doubt a statistically significant reduction in the inci-

dence of venous thrombosis following major abdominopelvic surgery when the oral anti-coagulant dicumarol was used prophylactically.

2. The reduction in mortality rate due to fatal embolism is statistically probable.

3. Conservative depression of prothrombin activity to 40 to 50 per cent of normal gave satisfactory prophylaxis and negligible hemorrhagic complications.

4. No evidence of liver toxicity due to dicumarol in the doses given was noted as revealed by fibrinogen determinations.

5. The necessity for rigid standardization of laboratory procedure for gauging the dicumarol effect is unequivocally essential for the success of a prophylaxis program.

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# SLIDING INGUINAL HERNIA OF THE COLON

## The Abnormal Peritoneal Folds and a Simple Safe Method of Restoration

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**A** SLIDING hernia may be defined as one in which part of the sac is formed by the serosa of the contained viscus. The colon in a sliding hernia has an adventitious surface which is not covered by any peritoneum either visceral or parietal (Fig. 1 lower left). This area is the mesenteric border and adjacent zones which have been denuded by unfolding of the leaves of the mesentery (1 2 3 5 7). The peritoneum of the mesentery is inside-out as hernial sac (6). The blood supply of the bowel is in its normal position along the mesenteric border but it lies in

areolar tissue and is not enclosed in the peritoneal coverings of the mesentery.

The diagnosis of the sliding nature of a hernia may be suspected clinically. It is not well retained by a truss. There is usually relatively little, if any constriction of the hernial mass at the inguinal rings. However the exact diagnosis is usually not made prior to operation.

The surgical treatment is somewhat dangerous if the surgeon does not understand the true nature of the lesion. (a) Inadvertent opening into the bowel may result from dissection to open the sac too far laterally. (b) If the operator attempts to treat a sliding or

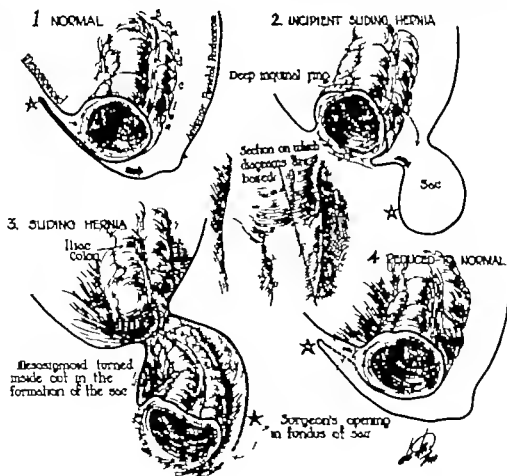


Fig. 1.

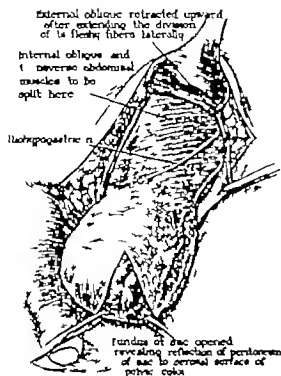


Fig. 2. Hernia opened and its sliding nature determined.

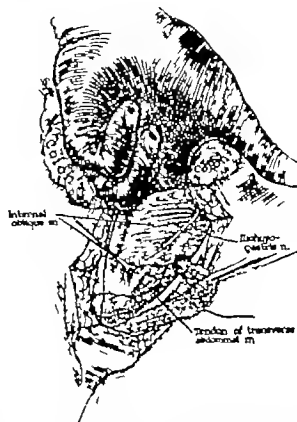


Fig. 4. Repair site palpated from within peritoneal cavity. Bowel held away from the groin behind operator's hand.

parapertoneal hernia as he would an old incarcerated hernia with adhesions, by dissecting the bowel free he will encounter the blood

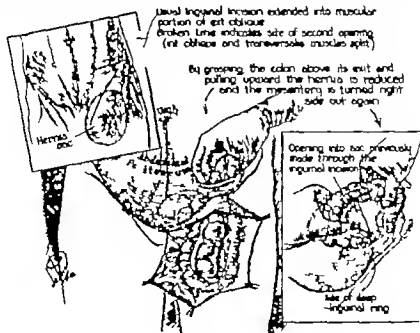


Fig. 3.

vessels (c) Attempts to repair the defect through exposure of the inguinal region alone tend to fasten the bowel at the groin. Thus the bowel and its blood supply are doubly endangered first in the dissection and then in the repair.

#### METHOD OF REPAIR

Repair of the inguinal canal is rendered safe and easy by reduction of the hernia by traction on the bowel from above through a separate opening into the peritoneal cavity (Figs 2 and 3). This can be done through the same skin incision by retracting the upper leaf of the external oblique aponeurosis and separating the internal oblique and transversus muscles in the direction of their fibers as in a McBurney incision (4, 5). Care should be taken to avoid injury to the iliohypogastric and ilioinguinal nerves and their branches by separating the muscles well above them. The hernia is reduced by traction from above and the opening previously made in the sac is now found in the lateral leaf of the mesentery near or at the intestine (Figs. 1 and 3). The bowel and its blood vessels are held away from the groin through the upper incision and a sound reconstruction of the inguinal canal may be accomplished easily and safely. The intra-abdominal aspect of the groin is palpated and inspected through the upper wound during the course of reconstruction of the posterior wall of the inguinal canal (Fig. 4). After repair of the posterior wall of the inguinal canal the rent in the lateral leaf of the mesocolon is closed through the upper incision. This may be done with some infolding of redundant peritoneum. The two leaves of the mesentery may be stitched together at an avascular point which is close to the root of the mesentery in order to prevent future unfolding.

Finally the muscle-splitting incision is closed and the external oblique aponeurosis is closed with appropriate imbrication.

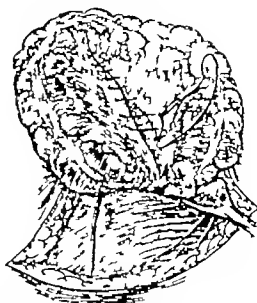


Fig. 5 Closure of the lateral leaf of the mesocolon. The opening was made when this peritoneum formed the fundus of the hernia sac.

#### SUMMARY

1. A sliding hernia should be suspected when there is a relatively large ring and the mass is not well retained by a truss.

2. Adhesions of bowel to hernia sac should not be confused with sliding hernia. Adhesions may be separated with safety. Dissection along the mesenteric border of the bowel in a sliding hernia is unnecessary and undesirable.

3. A separate opening into the peritoneal cavity enables the surgeon to restore the normal anatomic relationships and renders repair of the groin simple and safe while the bowel is held away from the line of suture.

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# RESECTION OF THE GREAT VEINS ON THE LATERAL PELVIC WALL

ALEXANDER BRUNSCHWIG MD F.A.C.S. and THOMAS S WALSH MD  
New York, New York

**P**REVIOUS experience has shown that ligation of the common iliac, external iliac, or hypogastric veins is feasible and may entail only moderate swelling of the leg when either of the first two of these vessels is occluded. The purpose of this report is to record the experiences obtained when large segments of the external iliac and the hypogastric veins with the terminations of the tributaries of the latter are resected (Fig 1). Such dissection was found to be necessary in the course of excision of malignant neoplasms primary in the uterus or adnexa which had extended laterally to involve these vessels. A perusal of the literature has not revealed reports of such procedures and of the sequelae incident thereto.

**CASE 1** Chr female 50 years of age. Hysterectomy in 1943 for neoplasm of the cervix, had been

From The Memorial Hospital Center for Cancer and Allied Diseases.

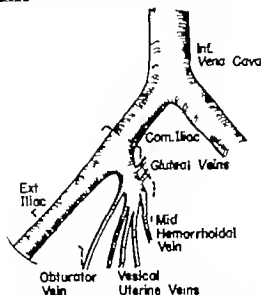


Fig. Diagram of large veins of pelvis showing segments resected (broken line). L., low portion of common iliac vein, most of external iliac vein and hypogastric vein with its branches.

performed in another institution. Irradiation therapy in various forms had been administered to the pelvis at intervals during 1944 to 1947. Pelvic examination revealed recurrent neoplasm involving the fundus of the vagina with firm induration extending to right pelvic wall. There were no rectovaginal nor vesicovaginal fistulas but the rectal and vesical walls seemed invaded by carcinoma.

On January 24, 1948, complete excision of the bladder, vagina, recurrent carcinoma and pelvic colon, with colectomy and bilateral arterial implantation into colon above colectomy was carried out. (Details of technique of this operation are described elsewhere.) In mobilizing the neoplastic mass that had extended to the right lateral pelvic wall it was observed that the external iliac vein had become obliterated and converted to a dense fibrous cord. The hypogastric vein and common iliac veins were patent and enlarged due to obliteration of the external iliac. The obliterated external iliac vein, the lower segment of the right common iliac vein and the right hypogastric vein were excised with all the pelvic viscera. Branches to the right hypogastric vein were divided at some distance from it. After operation there was marked swelling of the right leg but this did not seriously interfere with function; some cyanosis and pain were present. On the second postoperative day a right lumbar sympathetic block was carried out with novocain followed by symptomatic relief and disappearance of cyanosis. The block was repeated on a subsequent occasion.

The patient was discharged from the hospital on March 7, 1948, and since has been ambulatory. Swelling of the right leg persists but causes no interference with function (Fig 2). One year after operation the patient remains well and free from evidence of spreading neoplasm.

**CASE 2** SB female 52 years of age. In 1944, left salpingo-oophorectomy for malignant ovarian tumor was performed in another institution. During the past year patient has had severe pain in the right pelvis radiating to the back. She was admitted to Memorial Hospital in February 1948. Pelvic examination revealed a firm mass "frozen" into the right side of the pelvis. Operation was performed February 1, 1948. A neoplastic mass involving the right ovary and tube was found which had extended to the right pelvic wall and had become adherent to the right external iliac vessels. Separation from the artery was readily carried out; dense adherence to

Brunschwig, A. Complete Excision of Pelvic Viscera for Advanced Carcinoma, etc. Cancer (1948) 77.

the vein necessitated excision of most of the external iliac and the lower portion of the common iliac was also resected together with the hypogastric vein and its branches. Lymph nodes obviously containing metastases were resected from along the lower portion of the abdominal aorta and common and external iliac arteries as a part of the procedure.

Immediately after operation a lumbar sympathectomy block was performed (10 c.c. of 2% novocain in the right second and third lumbar interspaces). There was no swelling of the right leg until the second postoperative day. At this time a second block was carried out. The leg then felt warmer but swelling persisted. On the eighth postoperative day swelling decreased. At no time was there severe pain or impairment of function. Patient was discharged on the 21st day after operation and has since remained ambulatory. The swelling of the right leg confined principally below the knee has not caused functional impairment (Fig 3). One year after operation the patient remains well.

CASE 3. Stad female 58 years of age. Patient had previously received roentgen therapy in other

institutions for advanced carcinoma of the cervix. She was admitted to Memorial Hospital January 17, 1948, and pelvic examination revealed a large ulcerating neoplastic mass replacing the cervix. There was obvious invasion of the bladder. On February 3, 1948, an abdominoperineal excision of the uterus, vagina, bladder and neoplastic mass was carried out with bilateral ureteral implantations into colon. In excising the pelvic tumor it was necessary to remove the right external iliac vein together with the right hypogastric vein *en masse* with the neoplasm. The procedure was carried out in the presence of peri-aortic lymph node metastases as an attempt at palliation for severe pelvic pain and vaginal hemorrhage.

Following operation there was only slight swelling of the right leg and no pain. Paravertebral blocks were not deemed necessary. On the 13th postoperative day a fecal and urinary fistula developed in the perineal wound. She was discharged to a nursing home for terminal care. Pain had been relieved. She succumbed on March 11, 1948, and necropsy was not secured but there had been only slight swelling and no pain in the right leg.

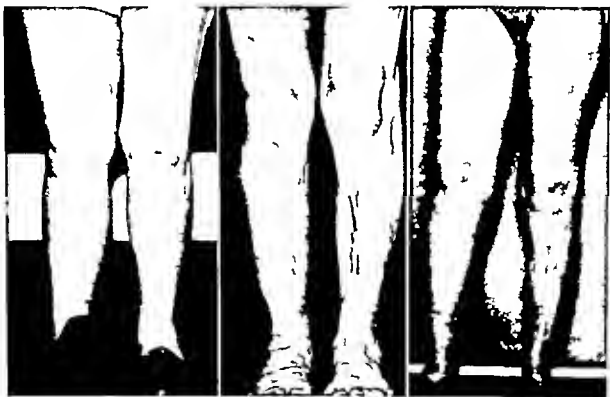


Fig 2

Fig 3

Fig 4

Fig 2. Case 1. Photograph showing moderate swelling of right leg 25 days after complete excision of pelvic viscera for advanced carcinoma of the cervix, during which procedure the obliterated right external iliac vein, lower portion of common iliac vein, and hypogastric vein with its branches were also resected. There was no appreciable functional impairment of right leg. Patient well and ambulatory 1 year after operation.

Fig 3. Case 2. Photograph showing slight swelling of right thigh and moderate swelling of right leg 20 days after resection of right external iliac vein and right hypogastric

vein performed in the course of excision of recurrent ovarian carcinoma. Patient well 1 year later with no appreciable functional impairment.

Fig 4. Case 4. Photograph showing moderate swelling of right inferior extremity 15 days after laparotomy for excision of massive recurrence and local spread of carcinoma of the vagina uncontrolled by irradiation therapy. The right external iliac vein, lowest segment of right common iliac vein and right hypogastric veins were excised *en masse* with the tumor. The swelling did not appreciably impair function of the right leg.

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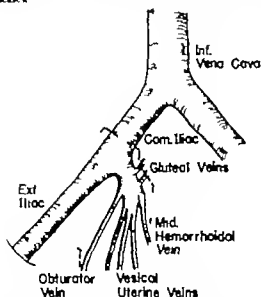


Fig. 1. Diagram of large veins of pelvis showing segments resected (broken line). i.e. low portion of common iliac vein, most of external iliac vein and hypogastric vein with its branches.

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The patient was discharged from the hospital on March 7, 1948 and since has been ambulatory. Swelling of the right leg persists but causes no interference with function (Fig. 2). One year after operation the patient remains well and free from evidence of spreading neoplasm.

**CASE 2:** S.B. female 52 years of age. In 1944 left salpingo-oophorectomy for malignant ovarian tumor was performed in another institution. During the past year patient has had severe pain in the right pelvis radiating to the back. She was admitted to Memorial Hospital in February 1948. Pelvic examination revealed a firm mass "frozen" into the right side of the pelvis. Operation was performed February 10, 1948. A neoplastic mass involving the right ovary and tube was found which had extended to the right pelvic wall and had become adherent to the right external iliac vessels. Separation from the artery was readily carried out; dense adherence to

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Fig 2

Fig 3

Fig 4

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Fig. 5. Case 4. Venogram taken 3 weeks after operation showing *S* saphenous vein injected in lower thigh. In the absence of right external iliac and hypogastric veins there is return of blood via *E*, subcutaneous veins of lower anterior iliofemoral and across *P*, perineum veins on left side.

**CASE 4.** L. T. Negro male aged 35 years. Patient had received irradiation therapy for epidermoid carcinoma of the vagina in 1916; the lesion was controlled but continued to spread until April 1948, when pain in right pelvis had become very severe. The pain also radiated downward to the right thigh and leg along the distribution of the sciatic nerve. Furthermore, the patient was not able to walk upright because of the pain but walked with hesitant gait, the body bent forward and to the right. Pelvic examination revealed a dense fibroscissous mass in the right adnexal region.

Laparotomy was performed April 29, 1948. Extensive carcinoma was found in the pelvis with metastatic nodes in the paraortic regions of the retroperitoneal abdominal spaces. In the right pelvis a spherical mass of neoplastic tissue about 6 cm. in diameter was deeply embedded and closely attached to the external iliac and hypogastric veins. It also appeared to be pressing against the roots of

the right sciatic nerve. The mass was excised together with the external iliac and hypogastric veins (the right hypogastric artery was divided and ligated) in an attempt at palliation to relieve the severe pain. (Panhysterectomy was also carried out.) Immediate recovery from operation was satisfactory. Paravertebral nerve block (right 1st and 3rd and 4th lumbar) with novocain was carried out on the eve of operation and repeated on each of the next 3 days. Two days after operation there was relatively little swelling of the right leg. The midportion of the right thigh measured 10.5 inches compared with 18 on the left; the right leg 13.5 inches compared with 12.6 on the left. After the patient became ambulatory swelling increased in the right leg but did not impede function (Fig. 4). The severe pain present before operation was relieved but because of advancing disease the patient was sent to an institution for terminal care a month after discharge from Memorial Hospital.

#### DISCUSSION

In view of the resections of external iliac, lower common iliac, and hypogastric veins, the return circulation from the inferior extremity in these patients must be via the large subcutaneous venous plexuses about the hip and perineum (Fig. 5). Subcutaneous veins of the affected leg did not become more prominent following operation. The experiences recorded above indicate that involvement of the external iliac and hypogastric veins does not afford in itself a contraindication for excision of these growths inasmuch as no distressing sequelae develop from such interruptions of the return circulation in one extremity.

#### SUMMARY

In 4 patients with advanced pelvic neoplasms, excisions of the latter were carried out *en masse* with lower segment of the right common iliac vein, most of the external iliac vein and the hypogastric vein with its branches. The inferior extremity on the side operated upon became somewhat swollen but was not very painful. Subsequent ambulation was not appreciably delayed or unpaired and the swelling subsided. Thus, such venous resections may be unhesitatingly carried out if necessary to excise large pelvic neoplasms.

# CARCINOMA OF THE CECUM COMPLICATED BY APPENDICITIS OR PARA-CECAL ABSCESS

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**C**ARCINOMA of the cecum with acute appendiceal inflammation or paracecal abscess has been reported previously in the literature in only 13 instances. Four more of these cases are added here from the records of the Presbyterian Hospital representing a review of 98 operations for carcinoma of the cecum during the 20 years from 1927 to 1947 inclusive.

Most of the patients with this dual pathology have been operated upon with the diagnosis of acute or chronic appendicitis and in a few instances, with the suspicion of the co-existence of carcinoma of the cecum. Their histories usually have been of short duration and indistinguishable from those of acute appendicitis and their physical signs those of a tender mass in the right lower quadrant.

The preoperative diagnosis between acute or chronic appendicitis with its frequently associated induration of the cecum and that of carcinoma of the cecum with infection or abscess is extremely difficult and usually has not been made. However by careful palpation an experienced surgeon should make the proper diagnosis in most instances if he bears in mind the possibility that the 2 lesions may be present at the same time.

Not infrequently the neoplasm of the cecum although not originating in the appendix has obstructed the lumen of the appendix and with superimposed infection has caused an acute appendiceal reaction and even rupture of the appendix with abscess formation. Occasionally a paracecal abscess will form without an apparent rupture of the appendix or the inflammatory reactions secondary to carcinoma of the cecum will obscure the underlying neoplastic process so that detection of the carcinoma is delayed. In a study of 3,400 cases of acute appendicitis Collins found

obstruction of the lumen of the appendix as the etiological factor in 50 per cent of the cases.

The persistence of a draining sinus, fecal fistula or painful right lower quadrant mass following appendectomy or drainage of an abscess has usually led to the ultimate discovery of the cancerous condition in the cecum.

It is the rule rather than the exception in most of the reported cases that some 4 to 6 months have elapsed between the operation for acute appendicitis or drainage of an infected area and the accurate diagnosis and resection of the advanced cancer of the cecum.

## HISTORICAL DATA

The first case of carcinoma of the cecum in association with acute appendiceal pathology was reported by Shears in an excellent paper in 1906 in which a primary resection and ileocolostomy was done. His report did not include an histological examination and the diagnosis depended upon the clinical impression of cancer of the cecum with mesenteric adenopathy. There was a very large thickened distended appendix which sprang directly out of the tumor itself very much like that of Case 1 of the present report. In these intervening 42 years very little has been added to the accurate recognition of the pathology and management of the case described by Shears except in respect to modern post-operative care and the amount of tissue removed which has been extended to include the large bowel up to the midtransverse colon instead of stopping the resection just above the cecum.

A careful search of the literature revealed nothing further on this subject until 1922 when Morton presented an excellent comprehensive paper on the differential diagnosis of malignant disease of the cecum from chronic and subacute appendicitis. He also presented a case illustrating this combination of pathology.

From the Department of Surgery, College of Physicians and Surgeons, and the Surgical Service of Presbyterian Hospital, New York.





Fig. 1 Gross specimen showing the ascending colon, cecum and terminal ileum with the carcinomatous tumor surrounding the base of the inflamed appendix.

serosa (Figs. 2 and 3). In the highly cellular areas of the tumor there were one or two mitoses per high power field (Fig. 4). A review of 17 lymph nodes showed no metastases.

**Diagnosis:** Carcinoma papillary type moderately well differentiated of the cecum, acute perianneitis.

The postoperative course was extremely satisfactory and the patient was discharged on the 9th postoperative day with good bowel function. Three years after the resection the patient was perfectly well and working at his usual occupation.

**CASE 2:** P.H. 286800 K.M. female aged 48 was admitted to the Presbyterian Hospital complaining of severe back pain beginning 4 days previously and of 3 days of severe generalized abdominal pain. She had been rather constipated up to the previous night when a cathartic was very effective.

Physical examination revealed an acutely ill middle-aged white female moaning with generalized abdominal pain. Abdominal examination revealed splinting of the right side with acute tenderness over McBurney's point. There was rebound tenderness in both lower quadrants. No mass was palpated. Rectal examination presented diffuse tenderness more marked on the right. Impression: Acute appendicitis with acute local peritonitis. Preoperative blood count showed white blood cells 22,000 with 88 per cent polymorphonuclear leucocytes.

First operation was performed June 2, 1933, drainage of appendiceal abscess.

About 100 cubic centimeters of cloudy turbid peritoneal fluid escaped when the peritoneum was opened. The cecum could not be delivered. The distal half of the appendix was buried in adhesions between the cecum and a loop of gut thought to be

sigmoid near the brim of the pelvis. It was impossible to see what the outer half of the appendix looked like. As the appendix was followed into these adhesions a cavity containing pus was entered.

Through an intermuscular incision the peritoneum was opened and the abscess cavity entered. After unsuccessfully attempting to remove the appendix the operator inserted 3 cigarette drains respectively into the pelvis, the abscess cavity and the lumbar gutter.

Following operation the temperature continued between 101 and 102 degrees for 12 days after which a low grade temperature continued until discharge on the 47th postoperative day. Pulse had ranged between 90 and 120. A rather marked secondary anemia persisted in spite of several transfusions. The morning after the operation, patient was noted to have a right hemiplegia including the face which had been present to a much less marked degree for a long time before the operation. For 4 weeks after the operation there had been a profuse foul fecal discharge from the wound but in the 5th week it had diminished to almost nothing.

September 22, 1933, patient was readmitted with a hard slightly tender nodule in the incision connecting with a large hard mass in the right lower quadrant thought to be a malignant tumor. She was weak and rather markedly anemic. Her bowels had been constipated and she was obstipated for 2 days about 1 week prior to this admission. Barium enema showed that cecum did not fill completely was not mobile and was less flexible than usual. Findings were consistent with carcinoma of cecum.

A second operation was performed October 4, 1933. At this time biopsy of the mass in the abdominal wall showed adenocarcinoma.



Fig. Low power of one half of the appendix, showing the lumen free, mucosa intact, submucosa normal except for fat replacement, which indicates an old inflammatory process, muscularis normal, subserosa preventing marked hyperemia and leucocytic infiltration.

A third operation was done October 11, 1933 (4 months and 9 days after drainage of abscess para-rectal thought to be appendiceal in origin).

There was a manifest tumor attached to the abdominal wall penetrating the skin. Attached to the mass intra-abdominally were 2 loops of small intestine and 1 of sigmoid which seemed to be involved by the growth. The adjacent mesenteric lymph nodes were enlarged and obviously carcinomatous. There were small masses covering the uterus and also in the broad ligament, probably metastases. The aortic nodes were obviously metastatic.

Because of the mass and extension along the lymphatic routes the lesion was considered to be hopelessly inoperable and no attempt was made to remove it or to resect the involved intestinal loops. Part of the growth that was protruding above the abdominal wall was coagulated and a good deal of it was removed with the electrocautery. The wound was closed after lymph node and part of the abdominal wall were obtained for histological examination, which showed adenocarcinoma on microscopic section following carcinoma of the cecum.

Patient was discharged in poor condition on the 23d postoperative day. She gradually deteriorated and died on December 13, 1933, a little more than 6 months after the first operation.

CASE 3. PH 435076 L.M. female aged 43, housewife, was admitted to Presbyterian Hospital after 3 weeks of suffering with a severe knife-like pain in the suprapubic region radiating to the anterior superior

ilium. This pain kept recurring and was attributed to intestinal gas. For the previous 3 or 4 days the pain in the right lower quadrant had been increasing in severity and frequency and was associated with sweating, chills and fever during the night. Appetite was poor but there was no vomiting.

Physical examination revealed an obese female in great distress. In the right lower quadrant was a soft, oval, nontender, slightly movable mass of about 7 by 4 centimeters. There was no distention, redness or fluctuation. There was considerable muscle spasm, but no rebound tenderness.

The urine showed some albumen and red blood cells. A kidney ureter bladder plate showed no kidney stones. A cholecystogram revealed poor filling and evidence of gall stones. Impression: acute appendicitis with abscess.

The first operation was performed November 5, 1934 and consisted of an appendectomy.

There was a small abscess at the base of the appendix containing about 5 cubic centimeters of pus. Distal to this the appendix lay embedded in a mass of firm tissue, most of which was thought to be mesentery of the appendix. The mass was about 4 by 3 centimeters and was adherent to loops of small intestine and other structures unrecognized in the pelvis. It arose from a broad base of retroperitoneal tissue.

Through a McBurney incision the mass was exposed and a adjacent abscess cavity was entered. A Welsh extension was made to expose the mass which



Fig 3. High power of peripheral portion of wall of the appendix with normal muscularis, leucocytic infiltration and hyperemia of subserosa. fibrin deposits on surface.



Fig 4. High power of glandular type of carcinoma of the cecum

was adherent to the posterior abdominal wall. It was debated whether to remove the mass or simply to drain the abscess. The mass abscess cavity and appendix were removed. No attempt was made to tie off the stump of the appendix. A double drainage tube was placed into the depth of the wound.

**Gross pathology.** There was a hard fibrous irregular nodular mass 6 by 3.5 by 3.5 centimeters which on section, showed densely organized scar tissue, an abscess cavity 1 by 1.5 centimeters filled with friable material and an appendix which was 1.5 centimeters in diameter having a wall 0.4 centimeter thick. The mucosa seemed absent in many places. No point of perforation from the appendix into the abscess cavity could be located. A loop of small intestine was attached to the cecum.

**Microscopic examination.** Most of the mucosa was preserved. The lumen of the appendix was filled with polymorphonuclear leucocytes, red cells and fibrin. In the mucosa and submucosa there was a very striking infiltration with lymphocytes. The mucosa was not especially edematous or thickened but the submucosa showed edema and a considerable amount of new fibrous tissue. The inflammation became more acute as the periphery was reached and there was a frank purulent exudate with some necrosis outside the muscular coat. Young granulation tissue was seen here. Diagnosis: chronic appendicitis, peritoneal abscess.

Postoperative course was very satisfactory. The wound sinus drained pus but no stool for 27 days. The wound was not quite healed on discharge on the 30th postoperative day.

Patient was readmitted April 1, 1935, for constantly discharging sinus since operation about 5 months previously. Sinus was never fecal.

A second operation was performed April 2, 1935. Exploration of the sinus of the abdominal wall showed that the sinus led to the cecum. The wall of the cecum was hard friable and red.

The tract was followed down to the cecum without breaking into the general peritoneal cavity. The wall of the cecum was opened in trying to expose the bottom of the sinus. Biopsy tissue from the cecum was taken and the opening was closed. Histological examination showed carcinoma of the cecum.

April 13, 1935, a barium enema showed slow and incomplete filling of the cecum, with a filling defect which constricted the lumen.

A third operation was carried out April 15, 1935 (5½ months after the appendectomy). Partial colectomy with end-to-end ileotransverse colostomy and resection of ileum with end-to-end enterocenterostomy and ileostomy were done. A small mass was felt in the cecum. None of the enlarged glands were thought to be metastases. The liver was found to be normal.

A transverse incision was made at the level of the umbilicus. The loop of small intestine attached to the cecum was inadvertently entered and it was then resected with an end-to-end anastomosis. The terminal 1 foot of the ileum and the large bowel up to the midtransverse colon were excised and an end-to-end ileotransverse colostomy was done. An ileostomy was then done in a loop in the right lower quadrant and the tube was brought out through the right lower quadrant wound. The right lower quadrant wound which was the site of a draining sinus and the transverse incision were closed except the skin and subcutaneous layers were tamponed open. A tube drain was placed down to the peritoneum in the lateral angle of the transverse incision as well as into the retroperitoneal tissue of the right lower quadrant.

**Histological study** showed a carcinoma of the cecum without extension of the tumor outside of the sinus tract, the wall of the cecum or into the lymph nodes.

**Follow up.** Patient was seen frequently and on October 5, 1939 (4½ years after resection of the



Fig. 2. Low power of one half of the appendix, showing the lumen free mucosa intact, submucosa normal except for fat replacement, which indicates an old inflammatory process, muscularis normal, subserosa preventing marked hyperemia and leukocytic infiltration.

A third operation was done October 11, 1933 (4 months and 9 days after drainage of abscess para cecal, thought to be appendiceal in origin).

There was a manifest tumor attached to the abdominal wall penetrating the skin. Attached to the mass intra-abdominally were 2 loops of small intestine and 1 of sigmoid which seemed to be involved by the growth. The adjacent mesenteric lymph nodes were enlarged and obviously carcinomatous. There were small masses covering the uterus and also in the broad ligament, probably metastases. The aortic nodes were obviously metastatic.

Because of the marked extension along the lymphatic routes the lesion was considered to be hopelessly inoperable and no attempt was made to remove it or to resect the involved intestinal loops. Part of the growth that was protruding above the abdominal wall was coagulated, and a good deal of it was removed with the electrocautery. The wound was closed after a lymph node and part of the abdominal wall were obtained for histological examination, which showed adenocarcinoma on microscopic section followed by carcinoma of the cecum.

Patient was discharged in poor condition on the 3d postoperative day. She gradually deteriorated and died on December 3, 1933 a little more than 6 months after the first operation.

CASE 3. PH 435076. L.M. female aged 43, housewife, was admitted to Presbyterian Hospital after 3 weeks of suffering with a severe knife-like pain in the suprapubic region radiating to the right iliac region.

This pain kept recurring and was attributed to intestinal gas. For the previous 3 or 4 days the pain in the right lower quadrant had been increasing in severity and frequency and was associated with sweating, chills and fever during the night. Appetite was poor but there was no vomiting.

Physical examination revealed an obese female in great distress. In the right lower quadrant was a soft, oval, nontender, slightly movable mass of about 7 by 4 centimeters. There was no distention, redness or fluctuation. There was considerable muscular spasm, but no rebound tenderness.

The urine showed some albumen and red blood cells. A kidney-ureter-bladder plate showed no kidney stones. A cholecystogram revealed poor filling and evidence of gall stones. Impression acute appendicitis with abscess.

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Through a McBurney incision the mass was exposed and adjacent abscess cavity was entered. A Wertheim incision was made to expose the mass which

this admission. The fistula continued to drain. The patient died on June 2, 1938, about 2 years after resection of the cecum from recurrence of the carcinoma of the cecum.

Of the 13 cases previously reported between 1906 and 1946 and the 4 added by the author, 6 were females and 11 were males, ranging in age from 23 to 69 years with an average of 46.4 years.

The carcinoma of the cecum was recognized and resected by an ileocelectomy at the first operation in only 4 instances. In all the other 13 cases there was a preliminary appendectomy or drainage of the right lower quadrant for an abscess or 'inflammation' in the region of the cecum.

In the 13 cases in which the carcinoma was not primarily resected there were 9 abscesses and in this group there were 5 persistent draining wound sinuses and 6 fecal fistulas, 1 of which developed after the 3d operation. It was the persistence of these draining wounds or fecal fistulas that led to subsequent biopsies of the sinuses or to exploration and finally to resection of the underlying carcinoma.

Histological studies revealed carcinoma of the cecum in 10 of the 17 cases. The 7 remaining presented only the surgeon's gross clinical diagnosis of carcinoma of the cecum. Generally there was no microscopic report on the appendix. Speese and Bothe reported an inflamed appendix. One of the writer's cases showed acute periappendicitis and an other chronic appendicitis with acute inflammatory reaction. In one of the cases here reported the pathologist could not find the appendix in the ileocelectomy specimen and it was presumed that it had become gangrenous and disappeared in the abscess stage.

In the majority of these cases a barium enema was not reported prior to the first operation, as most of the procedures were for acute appendicitis. However when it was reported it was usually inconclusive. In the later stages during the investigation of a persistent sinus or fecal fistula, there was usually found a filling defect, although in one of our cases the mass in the right lower quadrant was thought to be outside of the cecum. One cannot depend upon barium enema findings and should rely upon his clinical impression.

The follow up in these cases is entirely too inadequate to permit of any conclusions except that the results generally have been very disappointing and the outcome most unfortunate due in most instances to the failure to recognize the true underlying pathology at the first operation. The radical resection for carcinoma of the cecum was delayed generally for from 4 to 6 months after the initial appendectomy or drainage of an abscess or paracecal inflammation.

There were follow up reports in only 9 cases. These showed that 4 died of recurrence in from 3 months to 2 years after resection, 1 died of a stroke  $5\frac{1}{2}$  years after resection, 1 died of intestinal obstruction and empyema 10 weeks after the first operation and 3 were living and well respectively 8 months, 3 years and 6 years after resection.

#### DIFFERENTIAL DIAGNOSIS

Since both benign and malignant lesions of the terminal ileum and cecum produce symptoms and physical signs closely resembling acute appendicitis, accurate differential diagnosis of these lesions is extremely difficult, particularly when acute inflammation of the appendix and carcinoma of the cecum coexist. The proper diagnosis is facilitated, however, if one bears in mind the possibility that cancer of the cecum may occur in association with acute appendicitis even in a young patient in whom cancer is not ordinarily suspected.

Intestinal obstruction is rare with cancer of the cecum since the lumen is large and the fecal content is liquid. Anemia is often extremely marked in patients with cancer of the cecum and pernicious anemia should always be ruled out.

The entities which most commonly have to be differentiated from a cancerous mass of the cecum are appendiceal abscess with induration of the cecum and attachment of the omentum, regional ileitis with extension into the cecum, adhesions from previous operation in the right lower quadrant, tuberculosis of the cecum, usually secondary to pulmonary tuberculosis, occasionally diverticulitis, as reported by Christopher and Strode, and less commonly actinomycosis.



cecum) had no symptoms referable to the intestine. She had a cholecystectomy for acute cholecystitis and cholelithiasis in January 5, 1930.

About 6 years after her first operation for appendicitis and over 5½ years since the resection for carcinoma of the cecum, patient died suddenly of a stroke without having had any colon symptoms.

**CASE 4.** PH 485070, P. R., aged 60, female. First operation was in early November, 1935, in an other hospital, where drainage of a paracecal abscess and ileotransverse colostomy were done for right lower quadrant pain of 24 hours duration associated with a mass which matted together the terminal ileum, and cecum and extended into the pelvis. The character of the mass could not be determined and the appendix was not visualized. A paracecal abscess was entered and a biopsy of the adjacent tissue was reported as inflammatory tissue. The abscess was drained and an ileotransverse colostomy was done. Convalescence was satisfactory and patient was discharged in 3 weeks. The wound closed but 3 months after the operation it broke down and discharged pus.

She was admitted to the Clinic at the Presbyterian Hospital on May 3, 1936 for continued pain discharging sinus, and a mass in the right lower quadrant of 1 month's duration.

Physical examination revealed the abdomen soft, bare, and relaxed and presenting an irregular, tender, slightly movable mass in the right lower quadrant which filled the entire area from the iliac crest to the umbilicus. Barium enema revealed a well outlined cecum which seemed to be fixed. After a momentary delay a considerable amount of barium escaped into the ileum through an ileocolostomy. The mass in the right lower quadrant did not seem to be connected with the cecum. Re-examination by barium enema indicated that the mass, although in close proximity, was definitely outside the cecum.

A second operation was done on May 8, 1936 (about 6 months after the first operation) and consisted of a modified Mikulicz resection of the terminal ileum, cecum and ascending colon, and also an entero-enterostomy. A mass was seen just below the ileocecal junction with the cecum laterally and 3 loops of small intestine were adherent medially. A granulation tissue lined cavity with fibrous tissue periphery was present in the center of the mass. This cavity was continuous with the lumen of one of the small intestinal loops and probably also with the lumen of the cecum. No fecal material or pus was found in the cavity. A little gas escaped at one time from the opening into the small intestine. The liver could not be palpated because of dense adhesions. The appendix could not be distinguished but it was thought almost certainly to form part of the abscess cavity. A functioning ileocolostomy was present as done at first operation.

After excision of the old scar the cecum was mobilized. One could not be certain whether there was present a neoplastic or inflammatory process. I dissecting one of the loops of small intestine from the

cecum an abscess cavity was entered and found to be continuous with the lumen of the small intestine. The other loops were then dissected free and a biopsy was taken from the wall of the abscess cavity for frozen section which was said to be "suggestive of carcinoma." The loop of small intestine which had been entered was resected and an end-to-end anastomosis was done. The cecum was mobilized further the blood vessels were ligated and divided and a Rankin clamp was applied to the terminal ileum and ascending colon, bringing them together where they were fixed to the peritoneum in the upper angle of the wound. The ileum and colon distal to the clamp were excised and the clamp was left *in situ*. A double soft rubber tube drain was placed down to the retroperitoneal space. Some small fragments of tumor or inflammatory tissue were undoubtedly left behind attached to the 3 loops of small intestine that were not resected and also in the retroperitoneal space.

Histological study showed carcinoma of the cecum with extension to the ileum and metastases to the abdominal wall. Section of 7 lymph nodes showed only chronic mesenteric lymphadenitis. The appendix could not be found anywhere either in or on the surface of the specimen. The tumor had infiltrated through the muscular wall of the cecum and into the outer circular layer of the adherent ileum.

A third operation was done on May 27, 1936, an ileocolostomy side-to-side with Murphy button closure of colostomy and inversion of ileum. No evidence of tumor was seen. The parts of the ascending colon and ileum that represented a double barrel ileocolostomy were buried in adhesions and the opening was very small.

A transverse incision was made a little above the double barrel ileocolostomy opening. The colon and ileum were freed and an incision was made in the ascending colon and terminal ileum and a Murphy button was inserted into each opening and an anastomosis was made reinforced with Luken's gut. The terminal ends of the ascending colon, and ileum were isolated and inverted with 3 layers of sutures.

After operation the temperature continued between 101 and 102 degrees until the 30th day. She was discharged on the 63d day following the second operation (ileocolostomy).

Follow up August 20, 1936 wound was not healed and persistence of carcinoma was suspected. A large incisional hernia was present. Patient was referred for radiotherapy which was instituted on August 24, 1936 and up to December 15, 1936 she had 35 treatments, totaling 2400 rat units.

Patient was readmitted on March 10, 1937 for increasing abdominal pain with fecal fistula from the upper wound where the enterocolostomy with Murphy button was done. April 10, 1937 roentgenogram after the injection of the fecal fistula in the right abdominal wall showed apparent direct communication with the ascending colon.

On March 22, 1937 biopsy of the fistula showed no carcinoma. Patient was discharged to a convalescent home for terminal care on the 21st day after

this admission. The fistula continued to drain. The patient died on June 2, 1938, about 2 years after resection of the cecum from recurrence of the carcinoma of the cecum.

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Generally an inflammatory mass in the right lower quadrant is more fixed to the surrounding structures, while a cancerous lesion is fairly freely movable in the early stages although with perforation and abscess formation it is often fixed. The inflammatory mass is less circumscribed and less easily delineated than the neoplastic process. The cancerous lesion develops more gradually while the inflammatory process arises more rapidly. The inflammatory process presents more localized tenderness and muscle spasm except when there is perforation of the tumor with abscess formation. Fever and leucocytosis are usually more marked with an inflammatory lesion except with perforation of the cancer.

#### COMMENT AND CONCLUSIONS

The preoperative diagnosis of acute appendicitis and periappendicitis in association with carcinoma of the cecum is extremely difficult and is rarely made. Too frequently it has not been made at the first operation and therefore the indicated radical surgery has been unduly delayed.

Barium enema should be done in cases suspected of harboring a carcinoma of the cecum but too much dependence cannot be placed in the interpretation as small filling defects can be easily overlooked or the findings misinterpreted.

The persistence of a fecal fistula for more than 6 to 8 weeks following an operation for pathology in the cecal area should make the surgeon acutely conscious of the possibility of an underlying cancer of the cecum and should indicate further operative intervention.

Every effort should be made if the condition of the patient permits, to explore adequately the entire cecal area to determine the presence or absence of a carcinomatous lesion and to do a radical resection of the cancer under most conditions.

The presence of pus or abscess cavity in the vicinity of the cecum should not be a deterrent to satisfactory exploration. The patient has

already developed considerable natural immunity as the result of the abscess formation, and one may lose a golden opportunity to resect a cancer of the cecum because of the presence of pus.

Adequate biopsy should be taken if the surgeon cannot within reasonable limits, make a clinical diagnosis of cancer. A frozen section should be made if possible while the abdomen is still open.

A cecotomy should be done for palpation of the inner surface of the cecum where there is doubt about the diagnosis.

With markedly improved and selected anesthesia the free use of whole blood and the various antibiotics, together with proper attention to electrolyte balance and the employment of the Miller Abbott tube for purposes of decompression, radical surgery of the right colon is less dangerous than leaving in situ an unrecognized cancer of the cecum.

Early and radical operation is the only hope of cure in these cases of carcinoma of the cecum with acute appendicitis.

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# THE CORRECTION OF STRESS INCONTINENCE BY SIMPLE VESICourethRAL SUSPENSION

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A PROCEDURE for the correction of urinary stress incontinence has been devised which has given results approximating and often surpassing those which follow the commonly used operations. A description of this new attack upon an old problem is given as well as an account of a test devised to facilitate the selection of cases in which the outcome of treatment is likely to be successful. This procedure has been carried out on 50 patients to date. Thirty-eight cases were of the usual variety of stress incontinence in females and 25 of these had previously had a total of 40 standard gynecological operations without relief of this distressing condition. The remaining 12 patients were treated for unsatisfactory urinary control due to a variety of causes.

The basic plan of this procedure was derived from a study of vesical dysfunction following removal of the rectum (11). A high incidence of disturbance in the lower urinary tract chiefly retention followed excision of the rectum by either the abdominoperineal approach or the perineal route alone yet the incidence was low following operations omitting the perineal dissection. Traditionally this dysfunction has been ascribed to damage of nerves, but in this study no specifically neurological change could be demonstrated. Furthermore, transurethral revision of the vesical outlet in those patients having persistent retention after perineal rectal removal provided more satisfactory results than are usually obtained in instances of established neurogenic bladder. On the other hand transurethral resection after rectal excision was less satisfactory than in cases of simple prostatism. Accordingly it seemed apparent that a major factor producing retention after per-

neal excisions existed which was not neurological and which was not pure prostatism. An observation that most of the patients with this complication had mobility and marked sagging of the vesical base and outlet suggested that lack of elevation and fixation might be this unrecognized factor. In some cases firm upward pressure on the perineum with a fist or harness would provide temporary elevation and fixation and these patients could thereby void satisfactorily. In fact one patient declined transurethral surgery when he found that perineal support on voiding permitted emptying and relieved overflow in continence. From time to time mysterious cases appeared in which after removal of the rectum a transurethral prostatectomy relieved retention only to result in incontinence! Finally the following case seemed to integrate these observations and suggestions.

L. W. M. H. history No. 70735, a 54 year old male had complete urinary retention following abdominoperineal removal of the rectum. Neurological changes in the urinary apparatus could not be demonstrated. Two transurethral resections resulted in total incontinence even though the external urethral sphincter had not been damaged. Perineal pressure would provide good control. Simple suprapubic suspension of the vesical outlet by suturing to the pubis immediately and completely corrected his urinary control which has remained normal for a period of 46 months.

By analogy the knowledge gained from the study of these rectal cases was applied to the problem of the common stress incontinence of females. A simple operative elevation and fixation via the suprapubic route was planned but first a prognostic test was devised based particularly upon the observations regarding sagging of the vesical outlet and the effect of perineal pressure. This test provides simple temporary elevation and fixation of the vesical outlet as an evaluation for each case considered for operation. Its value was promptly appreciated because a successful result from

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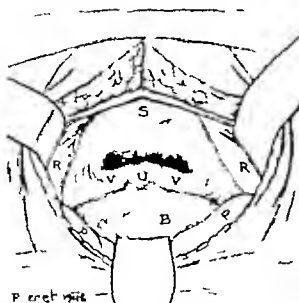


Fig. Operative area exposed and urethra U elevated from symphysis, S, R, rectus muscles, B bladder, P peritoneum, V upper surface of vagina.

the new operation was rarely obtained if the preoperative test was unfavorable. Further more the cause of some failures following the suspension and standard operations for incontinence can be revealed by this trial procedure.

The test was made by filling the bladder with 250 cubic centimeters of saline and observing the patient's urinary control while coughing and straining in the prone and standing positions. After the bladder was refilled to 250 cubic centimeters the same procedures were repeated with the exception that elevation and fixation of the vesical outlet was provided in the following manner: A wheel of novocain which was made in the vaginal wall at a point estimated to be under the interureteric ridge was grasped with an Allis clamp and held firmly upward toward the umbilicus not permitting downward movement on coughing and straining. If this elevation and fixation provided good urinary control the test was considered favorable. As accessory evidence pulling the vesical base downward toward the introitus caused poorer control. Use of the clamp attached to the wheel was more accurate than providing the support with a finger because the examiner

could be more certain that control was not afforded merely by compression of the urethra or vesical neck. Actually a finger just anterior to the cervix can provide the elevation and fixation without compression of the outlet if carefully done. Pressing the rectum posteriorly usually made control worse. Having the patient stop and start the urinary stream while the upward immobilization was maintained would indicate by the caliber of the stream whether or not the lumen of the outlet was constricted as well as further indicating the degree of control obtained.

The first female patient (I. B. M. H. history number 58436) selected for simple suprapubic elevation and immobilization of the vesical neck and urethra was 51 years old complaining of constant painless leakage of urine from the urethra for years except when in bed. Even though pads were worn constantly she was required to change her clothing at least twice daily. A mild cystourethrocele was present. Urinalysis and cystoscopy were unremarkable. No psychiatric nor psychosomatic disorder was evident. The previously described test was favorable.

On June 8, 1944, under general anesthesia, the following operation was performed and the technique has not been altered essentially in subsequent cases. A No. 24 F. Foley catheter with a 30 cubic centimeter balloon was placed into the bladder transurethrally and the bag inflated. The patient was arranged in Trendelenburg position with emphasis on the elevation of the pelvis proper rather than merely lowering the head of the table and bending the knees downward (19). A suprapubic incision was made to expose the space of Retzius widely. Light pressure on the top of the bladder and the urethra with a sponge on ring forceps readily separated the bladder and urethra from the posterior surface of the pubis and rectus muscles down to 1 centimeter or less of the external urethral meatus. The suspensory attachments between these structures were extremely delicate bearing only the faintest resemblance to the tough puboprostatic ligaments of the normal male. An assistant's fingers in the vagina aided the palpation of the catheter and balloon which corresponded to the urethra and vesical neck respectively. Three sutures of No. 1 chromic catgut were placed equidistant from each other on either side of the urethra. The su-

turing needle was inserted deeply into the upper wall of the vagina adjacent to the urethra and through the lateral wall of the urethra, caution being exercised to avoid entering the urethral lumen. A double hit was taken to insure a secure hold and also to place eventually as large an amount of tissue as possible in apposition to the pubis. A similar suture was then placed on either side of the vesical outlet in the angle between the balloon and the catheter after the balloon had been pulled down to mark the outlet. When upward traction was made on the long ends of these eight sutures the urethra and vesical neck were lifted away from the introitus which change was particularly noticeable by the assistant who had two fingers in the vagina. At this stage additional sutures were placed at points of advantage lateral to the urethra where the vaginal wall apparently sagged that is one additional suture on each side but the number has varied according to circumstances in subsequent cases. With a curved round-edged needle the long ends of these sutures were placed securely through the periosteum of the pubis, especially into the cartilage of the symphysis whenever feasible. The locations for these sutures in the pubis or rectus muscles when indicated were carefully selected in order that when the sutures were tied they would move the urinary passage upward and backward from the introitus. Upward displacement by the assistant's fingers in the vagina aided the selection of these sites and avoided undesirable tension until a sufficient number of the sutures had been tied. Thus the space of Retzius was closed and a wide area of the superior surface of the urethra and vesical neck opposed to the symphysis and the posterior surfaces of the rectus muscles. Additional sutures were now placed in the musculature of the lower and lateral portions of the bladder with their long ends in the posterior parts of the rectus muscles and tied to further pull the bladder anteriorly into the space of Retzius. One small rubber drain was inserted in the wound for the same reason that chromic catgut sutures were used instead of silk, namely, better to protect the field of operation should urinary leakage occur as a result of any of the sutures having

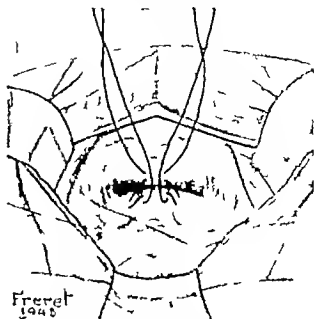


Fig. 2. Lowest suture on either side in place.

penetrated the urinary lumen. The abdominal wound was closed in a routine manner.

Inspection following the procedure revealed no cystourethrocele and only the barest motion of the urethra on straining. With the patient lying horizontally the long axis of the urethra was close to a 45 degree angle with the floor instead of parallel as before the operation. The external urethral meatus appeared retracted inward and upward. The Foley catheter was attached to the thigh by adhesive tape in order to absorb any accidental traction contrary to the purposes of the operation. The urine contained gross blood for 2 days after operation. The drain was removed on the second postoperative day and the catheter on the seventh.

In the 34 months following operation this patient has not worn a perineal pad or other protection and has not been incontinent. She has worked moving office files without urinary incontinence and can safely cough and sneeze. In addition there has been no recurrence of the cystocele. The urinary stream is of large caliber and forceful. Two hundred fifty cubic centimeters of water placed in the bladder is retained and voided normally without leaving any residual. She voids on the average of five times a day and occasionally once at night.

In selecting additional candidates for this operation the value of the previously described test was not only emphasized but certain other conditions frequently required exclusion by specific measures. When stress

incontinence coexisted with other diseases which may cause urinary dysfunction the differentiation of the degree of trouble attributable to each disorder separately was often difficult. The commonest disease co-tused and coexistent with stress incontinence was chronic nonspecific urethritis with or without cystoscopically observable trigonitis. This frequent coexistence of incontinence and urethritis suggested that their relationship was etiologically more than fortuitous particularly as the correction of one often decreased the symptoms due to the other. Generally speaking the urethral irritation was the more easily treated of the two. Those patients with urethritis as the major factor producing their complaint were usually found on careful questioning and observation to have marked urgency and frequency rather than actual loss of the mechanics of retention. They had the desire to void which might be sudden and irresistible and then wet themselves. They however had some warning. The truly incontinent patients would wet themselves without warning (except as only experience might have taught them that certain activities usually caused leaking). A therapeutic trial of slowly progressive urethral dilations to open the ducts of the urethral glands, followed by instillations into the bladder and urethra of 1:5000 silver nitrate at weekly intervals, and accompanied by two sitz baths daily of 15 minutes each usually produced marked improvement by the second or third week if urethritis was a major factor causing symptoms. The source of such urethral infection was sometimes evident in the vagina, cervix, periurethral ducts and glands or in a urethral caruncle. Correction of these disorders, when they existed, was occasionally of paramount importance. Other more generally recognized causes of cystitis or urethritis were excluded particularly if the urinalysis was abnormal, tuberculosis, neoplasms, urethral obstructions, fistulas, renal infections, etc. Hunner's ulcer usually produced a characteristic history of pain with bladder distention and cystoscopy established that diagnosis. Fully developed neurogenic bladders were usually suspected from the history and general examination but in the incipient stages

the differentiation from non neurogenic incontinence was difficult. Occasionally females were found to have large residual urine and thereby overflow or paradoxical incontinence—not a weakness of the retaining mechanism. Cystoendoscopy, trial therapy for urethritis, a simple neurological examination, complete urinalysis, estimation of renal function and finally the inquiry into the patient's psychological reactions seemed important in the selection of candidates for this new operation in addition to the described test. It will be pointed out later that some of our failures can be attributed to poor selection rather than to the operation itself which is not designed to cure all types of incontinence.

Following the first 2 cases just described an additional 48 patients, 4 male and 44 female, have been operated upon. They had various lesions causing poor urinary control and various bases for selection. The results have been excellent in 32 of the total number of 50 patients, good but not excellent, in 6, improved but not satisfactory, in 3, failures in 9, but none had worse control than before operation. This gross tabulation does not present the true value of the method though it does indicate the existence of limitations. If the results for those cases preoperatively selected as favorable by the advised study are tabulated the effectiveness of the procedure is apparent of 44 so selected, 36 (82%) are excellent results, 3 (7%) are improved and 5 (11%) are failures at the time of this writing. Furthermore the reason for not obtaining excellent results is obvious in 4, sutures insecurely placed (the first attempt of an operator not familiar with the details of the procedure), excessive scarring which did not permit elevation by the suprapubic route alone due to lymphogranuloma in 1 case and due to previous surgery with infection in another and wound infection. The cause of a fifth incomplete result is uncertain. The patient stated she was greatly improved when seen in our follow-up clinic but when seen later outside the hospital said she still leaked and she will not return to the clinic for evaluation. After leaving the hospital 3 patients control became weak from cause unknown.

except in 2 of these a partial recurrence followed unusual straining

The largest single group in the series is perhaps the most important not only because the best results were obtained but also because it represents the commonest variety of incontinence. The group consists of 38 female patients having the common variety of so called stress incontinence that is the type generally recognized as being due to relaxation especially following deliveries or the endocrine changes of aging, the variety considered suitable for such standard operations as those devised by Kelly, Kennedy, Aldridge, Studdiford and others. Furthermore, 25 (66%) of the patients in this group had had 40 standard gynecological operations of types which are recognized to provide good control routinely, but which had failed in these cases. Twenty nine (76%) of these 38 patients had control so poor that urine leaked out of the urethra even while in bed or leakage was so constant when up and about that only occasionally did they retain enough to void a stream. These 29 could be termed 'soakers'. Eight others were protection for their clothing or changed clothes daily because of wetting at least 5 days out of 7. One patient had only mild difficulty but poor control was demonstrable the suspension operation being done incidental to the removal of an ovarian cyst. All 38 patients came to the hospital to request treatment to improve their control. Preoperatively 37 were considered suitable for the new operation. The thirty-eighth case was an error in selection and this error was the obvious cause of failure. The patient had had 2 vaginal operations to gain control which resulted in a urethra and vesical neck so scarred as to contain almost no functioning muscle. The walls of these structures were paper thin apparently consisting of only a mucosal lining inside and vaginal epithelium outside. The urethra was approximately 1 centimeter in length. The supportive test was equivocal preoperatively and postoperatively this trial procedure remained unfavorable. Only broad firm compression of the vesical outlet (not merely the urethral remnant) against the pubis permits retention of more than a few cubic centimeters.

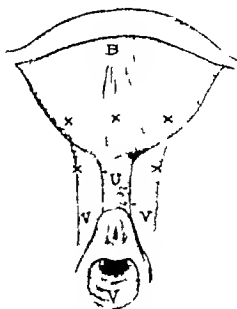


Fig. 3. Diagram of sites for sutures. Dots are for sites along urethra and vesical neck. Crosses, for sites in lower bladder and vagina. Other sutures are often taken as explained in text.

Of the whole 38 cases of this female group with so called stress incontinence 28 or 74 per cent have entirely satisfactory urinary control at the time of this writing from 1 to 35 months after operation. By entirely satisfactory is meant that the patient does not wear protection for her clothes, does not even get damp in spite of pursuing her usual activities and voids without difficulty. Seven 18 per cent have evident improvement but the result is not completely satisfactory. One of these 7 is a 72 year old female who had normal control until a cystocele was repaired after a radical vulvectomy for carcinoma. The cystocele was corrected but heavy scarring around the vagina resulted which seemed to hold the urethra and vesical neck down. After the suprapubic suspension she no longer leaked in bed voided regularly and usually stayed dry for 20 to 40 minutes after each voiding during the day—all in direct contrast to her preoperative status. However leakage occurs so easily she must wear protection during the day. A satisfactory pessary cannot be fitted but manual support still improves control if enough pressure is used to release the downward tension of the vaginal fibrosis. Four others in this group of improved but not satisfactory results show approximately the



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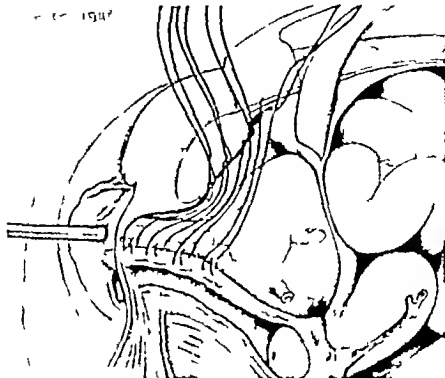


Fig. 4. Sagittal section showing the four para-urethral sutures on the left.

same degree of improvement as in the case just described they do wet themselves, yet not enough to be soakers. Two patients are personally pleased. The other two while improved are not personally pleased by the amount of control returned. All considered it can be academically stated that 92 per cent of the patients postoperatively show a change in urinary control definitely for the better. Three 8 per cent of the 38 are complete failures, one being due to improper selection as described. (The cases of incontinence due to lymphogranuloma and transurethral resection of the vesical neck are not included as being the usual type of female urinary incontinence though the cases have items in common.)

These results compare reasonably well with reports in the literature concerning the results of other operations designed for the cure of this type of incontinence. Kelly and Dumm reported 20 per cent failures with the now famous Kelly operation. The results of 105 vaginal operations for obtaining urinary control were reported by Watson as satisfactory

in 65.7 per cent, improved in 21.9 per cent, and unimproved in 12.4 per cent. Berkow using an operation consisting of advancement of the urethral meatus and sub-urethral reefing had 2 failures in 21 attempts (9 per cent). Kennedy (7, 8, 9) after a detailed study of the anatomy and physiology concerning micturition devised a vaginal operation similar in part to Kelly's plans with which he has had only 7.1 per cent failures. Studdiford using Aldridge's fascial sling operation had 4 failures in 15 attempts (26.6 per cent) but with Studdiford's modification 27 of 30 were successful (100 per cent failures). Te Linde reports 90.3 per cent well, 5 per cent improved and 3.5 per cent unimproved with a Kelly type procedure used selectively 249 times.

The details of the follow-up of cases, including definition of terms and time elapsed since operation are seldom indicated in the literature. Most of the results reported are immediate outcomes, yet late recurrences are recognized not to be rare. One author (14) reported 45.5 per cent recurrence of poor urinary control when 78.4 per cent had been

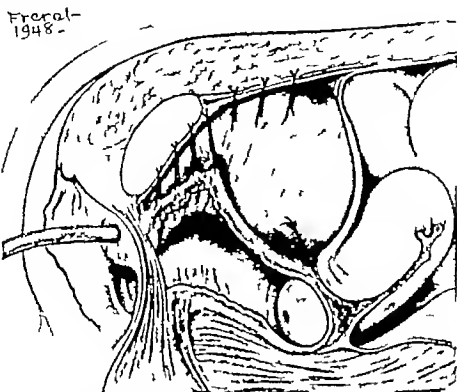


Fig 5 Same as Figure 4 except sutures tied—diagrammatic, as actually less space remains between origin and insertion of sutures.

satisfactory immediately following anterior colporrhaphy. In the present series 3 recurrences of poor control have appeared since discharge from the hospital 2 within 6 months and 1 later. Onset of recurrence was with lifting or severe coughing in each case. The other unsatisfactory results were evident upon removal of the catheter after operation. The follow up time between operation and the last definite record regarding urinary control varies from 1 to 35 months with 28 having been followed 6 months or more, 16 one year or more and 5 two years or more. All patients have been seen since discharge. The effect of pregnancy and especially vaginal delivery upon the suprapubic suspension has not been tested but from general considerations we advise these patients against pregnancy.

A review of the literature might lead one to believe that the standard gynecological operations for incontinence rarely if ever made the patients condition worse yet experienced gynecologists are aware of such complications as vaginal fistulas, ureteral fistulas, ureteral ligation and poorer control. None of these occurred in the present small series but because of the operative approach the incidence

of these complications should be exceedingly small. One patient's urethra was so adherent from 4 previously unsuccessful operations that an opening was inadvertently made into it which was sutured. A small amount of urinary drainage occurred suprapubically for 7 days after which the fistula closed spontaneously. This patient had normal control 6 months later. Two psychiatric patients with both enuresis and partial incontinence were cured of the incontinence but not of the enuresis (though one wet the bed only once in a year after operation). Often the patients had frequency and urgency until the irritative effects of the indwelling catheter and infection were overcome after operation. Two wound infections occurred both were mild and neither required additional drainage but in one of these a hernia later developed. One other patient has a ventral hernia but this is apparently the result of a previous suprapubic operation. Two hematomas occurred but did not impair the result. One patient had an attack of acute cholecystitis during her hospital stay and one had pains suggesting osteitis pubis which promptly subsided. There were no deaths.



colostomy reduced the residual to 75 to 200 cubic centimeters but a wound infection disrupted the suturing with resultant return of the same degree of retention.

The case of a male patient having a successful suprapubic suspension after removal of the rectum and transurethral resections was outlined at the beginning of this article. One additional case, almost exactly similar has shown improvement the patient is pleased but he does leak at times so the result is classed as improved but not satisfactory.

Of three male patients having unfavorable supportive tests preoperatively only one obtained improvement though none became worse. Two were incontinent after suprapubic prostatectomies done elsewhere and one after accidental transurethral incision of the external sphincter by us.

#### DISCUSSION

The word *new* is used advisedly in referring to this simple suprapubic vesicourethral suspension. As far as we can determine the procedure as a whole is new for *incontinence*. Hepburn (4, 5) and later Miller (12) used a similar technique for *prolapse* of the female urethra, but not primarily for the correction of incontinence. However Miller (12) remarked that 1 of his 3 patients had better control following operation so that the procedure might cause improvement. Others notably Perrin and Williams have sutured the top of the vesical outlet to the symphysis and thereby improved control. Apparently they did not suspend and fix the urethra also. Suprapubic Kelly type plications, some successful have been reported by Furniss and others. Suprapubic transvesical operations (10, 22) may have had part of their success due to the unrecognized adherence of the vesical neck to the symphysis postoperatively. The mere conception of elevating and fixing the outlet is by no means new but surprisingly is frequently ignored.

The exact mechanism by which this operation improved urinary control in most of the selected cases is not entirely understood. However simple elevation and fixation of the vesical outlet and urethra seem to be the only

significant change that can result from the technique. No muscles are plicated and no hammock like support is constructed under the sphincter. Most sphincters have two or more relatively firm attachments and perhaps the major achievement of the operation is providing such attachment. The recent work of Rose particularly stresses the importance of these attachments in contributing to normal urinary control.

#### SUMMARY

The development of a new operation for certain types of urinary incontinence has been described. A preoperative test consisting essentially of temporary elevation and fixation of the vesical neck and urethra has permitted the selection of those candidates who have an excellent chance for improvement by the operation and which at the same time seems to indicate those whose postoperative result will not be good. The operation is a simple elevation and immobilization of the vesical neck and urethra by suturing them to the pubis and rectus muscles. Of 44 suitable cases excellent results were obtained in 36 (82%) significant improvement in 3 (7%) and no improvement in 5 (11%). The causes of most of the failures seem evident and are discussed. The most significant group reported consisted of 25 patients with the common variety of female stress incontinence which had failed to be corrected by one or more standard gynecological procedures for incontinence. Of these 25 patients 19 have normal control from 1 to 35 months after this new operation with 21 having been followed 6 months or more. Poorer urinary control did not result in any instance.

It is not the intent of this presentation to advocate this operation to the exclusion of others. As can be seen the procedure is followed by failures in 10 to 15 per cent though careful use of the described preoperative test should permit better selection and thereby fewer failures.<sup>1</sup> The intent is to emphasize two principal points: first that elevation and

<sup>1</sup>Since preparation of this article an additional 20 patients have been operated upon by this technique. Nineteen have excellent results and the follow-up is incomplete in the other case.

fixation of the vesical neck is a major factor in the maintenance of urinary control and second that this operation is worthy of trial in selected cases in which previous surgery has failed

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## INTRAMEDULLARY BONE FIXATION IN PATHOLOGIC FRACTURES

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IT is the purpose of this paper to report our experience with the Kuentscher intra medullary nail in the treatment of pathologic fractures of the long bones. Numerous references have appeared in regard to the use of the Kuentscher nail for the treatment of simple and compound fractures (1, 3, 4, 5, 7). Infrequent mention has been made of its use in the treatment of pathologic fractures (2, 4, 6). It is not within the scope of this paper to review the reports which have accumulated regarding its use in the general treatment of fractures. However, as we gained experience with this method in the treatment of simple fractures in nonunion and other complicated fractures of long bones, we observed that the method has singular value in overcoming the troublesome problems associated with pathologic fractures and justify this additional report to the already extensive literature on the subject.

The ideal method of internal fixation of bone would be one in which the necessity for open reduction at the fracture site could be circumvented. The fixation should be such that immobilization in a plaster cast would be unnecessary. Weight bearing and free motion of the adjacent parts should be permissible at the earliest possible time. Finally, there should be maximal opportunity for callus formation and minimal interference with normal bone healing. These tenets apply particularly to the peculiar problems of pathologic fractures, although all are not always attainable. Thus, for example, the fact that such patients are sometimes in the terminal stages of their illness makes it undesirable to immobilize the extremity in plaster. In such instances, intramedullary nailing makes it possible for patients with generalized carcinoma to return to the care of the family and insofar as the fracture is concerned to be

pain free and comfortable for the remainder of their lives. Again, the factor of facilitating nursing care in these patients is an important one.

While the above remarks are not altogether applicable to Paget's disease (osteitis deformans), the peculiar mechanical conditions imposed by the brittle bones in this disorder, the high frequency of transverse fractures, and the occasional complication of delayed union render this method very useful in attaining a satisfactory mechanical reduction. In our experience with Paget's disease, early healing of the fracture followed in every instance.

**Technique.** The following remarks pertain to the technique of reduction and internal fixation of pathologic fractures of the femur, since in every instance of this series this was the bone involved (3, 5, 7). In each instance, the patient was placed on the fracture table in traction and in lateral decubitus position. In 5 instances, general anesthesia (pentothal and nitrous oxide) was employed, and in the remaining 5, spinal anesthesia was used. The affected extremity was slightly flexed at the hip and adducted, thus providing easy access to the region of the greater trochanter. A linear vertical incision sufficient to allow drilling of the bony cortex was made at the trochanteric fossa. When occasion demanded, this incision was extended distally in order to permit open reduction at the fracture site. In 8 instances, open reduction at the fracture site was effected, and on each such occasion, a hipspys was obtained. A guide rod was introduced through a drill hole and passed through the medullary cavity across the fracture site, fixing it. The nail was then driven over the guide, and the guide removed. The wound was closed with interrupted silk. The course of reduction and fixation was followed by the use of portable roentgenograms taken in the operating room in both the anteroposterior and lateral planes.

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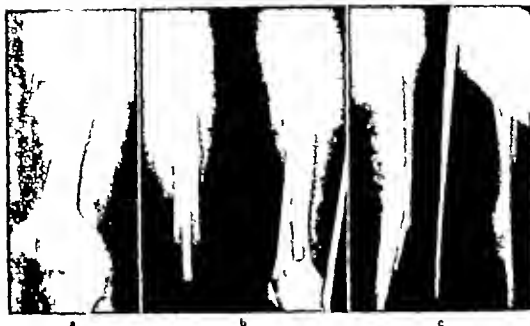


Fig. Case. Roentgenogram taken April 6, 1947 shows a pathologic fracture through femur in which I by Paget disease. b, after insertion of intramedullary nail, April 18, 1947. c, 3 months after insertion of intramedullary nail, July 2, 1947.

#### CASE REPORTS

**CASE E.T.** a 52 year old laborer was admitted to the surgical service on April 16, 1947 with the complaint of a broken left thigh of 3 days duration. He also gave a history of periods of unconsciousness, occurring intermittently for the past 7 years. The patient stated that he had had a Colles fracture of both wrists in 1932, a fracture of the right femur in 1937 and a fracture of the left tibia and fibula in 1945. There was inadequate history of trauma with these fractures. Three days prior to this admission he experienced another episode of unconsciousness and fell to the sidewalk, which resulted in the present fracture.

Examination on admission showed a well developed and well nourished white male not acutely ill. The left lower extremity was in Thomas splint traction. The chest and heart were normal to percussion and auscultation. Inspection of the patient's fingers showed definite evidence of clubbing and pulmonary osteoarthropathy. Inspection of the patient's left thigh showed a moderate amount of swelling and subcutaneous extravasation of blood. There was a false point of motion about the mid-shaft of the left femur and point tenderness in this area. Roentgenograms showed an oblique fracture through the shaft of the femur at the junction of the middle and lower one-thirds. The cortex of the bone about the fracture site appeared unusually thick while the bone about the knee joint appeared atrophic. The appearance was suggestive of a pathologic fracture through an area of Paget's disease. A roentgenogram of the chest showed generalized pulmonary fibrosis.

On April 17, 1947 under spinal anesthesia, a Kuestcher intramedullary nail was inserted into the left femur. Open reduction at the site of fracture was not necessary in this instance. Postoperative roentgenograms showed the intramedullary nail in place in the medullary canal across the fracture site with slight anterior tilting of the distal fragment. The anteroposterior view showed excellent alignment. The patient's postoperative course was uncomplicated. He was able to sit up in a chair on the 3rd postoperative day and was permitted to bear weight on the extremity with the help of canes 1 week after the operative procedure. He was discharged on the 14th postoperative day with the instruction not to bear weight without the aid of support.

He was seen again on June 10, 1947 at which time examination of the left lower extremity showed a normal range of motion of the hip and knee joints. The patient had been able to walk with canes or with the aid of one crutch for several weeks. Roentgenograms taken at this time showed union at the fracture site however the healing did not appear complete. He returned again to our service on July 23, 1947 at which time good union and heavy callus formation was seen in the roentgenograms. It was observed that there was slight bending of the nail. The patient had been ambulatory.

**CASE C.F.**, a 60 year old man was admitted to the surgical service on April 25, 1947 with the complaint that 24 hours before admission he suffered a fracture through the right thigh. He stated that he had been sitting and shifting his right lower ex-

tremity when a spontaneous fracture occurred. The patient gave the history that during September 1944 he had what was thought to be a neoplasm involving the alveolar ridge of the left maxilla which was resected at that time. He also had bilateral radical neck dissection during September 1944. In September 1945 the patient suffered a fracture through the lower third of the right femur. The diagnosis at that time was a pathologic fracture. It was treated by open reduction. A biopsy was taken which showed probable metastatic carcinoma in the femur. This oblique fracture was treated by his local physician by application of a metal band application of a plaster cast and intensive roentgen therapy. Following this procedure he got along well for 1½ years until 24 hours before his admission to this hospital.

Examination on admission revealed an operative intraoral defect of the left maxilla communicating with the nasal cavity. Bilateral surgical scars were present over the neck. Inspection of the right lower extremity showed deformity, swelling and tenderness about the mid femoral region. A scar was present over the lateral aspect of the thigh just above the knee. Roentgenograms of the right femur revealed a pathologic fracture at the junction of the proximal and middle one thirds with medial displacement of the distal fragment. There was evidence of an old healed fracture approximately 10 centimeters distal to the present fracture. There was a metal band about the old fracture site. The bone appeared firmly united. Extensive search for an other primary site for the possible bone metastasis to the right femur revealed no demonstrable lesion. It was thought that the left maxilla was the site of the primary neoplasm.

On April 26 1947 under spinal anesthesia, a Kuentscher type nail was inserted without undue difficulty. Open reduction at the fracture site was not necessary in this instance. The patient's postoperative course was quite uneventful and there was immediate relief of pain at the fracture site. He had a relatively stiff knee preoperatively perhaps as a result of the prolonged immobilization in a cast during his previous fracture episode. Postoperative roentgenograms showed the intramedullary nail in place with satisfactory position and alignment of the fracture involving the mid-shaft of the femur. The patient was discharged on the 13th postoperative day.

The patient returned on July 15 1947. Examination revealed the right thigh to be strikingly increased in diameter mostly around the site of the previous fracture. Roentgenograms revealed no evidence of union and showed definite extension of the neoplastic process. The patient was treated with irradiation with some improvement. He returned again on September 26 1947 at which time the right thigh was greatly increased in circumference with a mass involving most of the thigh but the patient was still quite comfortable and pain free. Roentgenograms on September 26 1947 showed no evidence of bony union at the recent fracture site

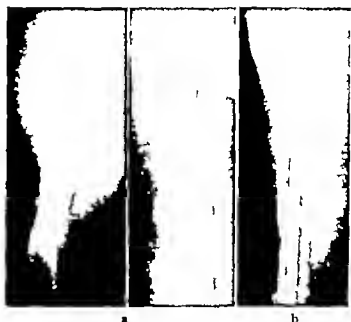


Fig. 2. Case 2. a, Pathologic fracture through an area of metastatic carcinoma, April 26, 1947. b, after insertion of intramedullary nail May 6 1947.

and there appeared to be more destruction of bone at the fracture site from the known neoplasm. Roentgenograms of his chest revealed no evidence of neoplastic metastasis. He was again given intensive irradiation therapy and on October 13 1947 biopsy specimens of tissue from his right thigh were taken which revealed only hyalinized muscle and fibrous tissue. During this hospital stay the patient developed some rectal bleeding. Examination revealed several small nodules about 2 centimeters superior to the anal margin. A biopsy was made from these nodules and sections showed probable malignant neoplasm, the origin of which could not be stated definitely. At the time of discharge from the hospital the patient had extensive destruction of the right femur, the intramedullary nail still holding the ununited fracture ends in satisfactory position.

CASE 3. M.D. A 56 year old man was admitted to the surgical service on March 17 1947, a few hours after a tractor accident in which he suffered a compound fracture of his right tibia and fibula and a fracture of his left femur and multiple contusions. Roentgenograms showed a subtrochanteric fracture of the left femur through an area of bone which appeared to be involved by Paget's disease. Roentgenograms of the right tibia and fibula showed a transverse fracture of the upper portion of the tibia and a transverse fracture of the fibula at the junction of the lower and middle one thirds.

The patient was treated in balanced traction with a Steinmann pin through the lower femur on the left and his right extremity was placed in traction on a Boehler frame with a Steinmann pin through the os calcis. Clinical evidence of gas gangrene developed in the compounded injury of the right lower extremity however under intensive treatment the infection remained localized. Roentgenograms taken





Fig. 3. Case 3. a, Refracture 3 months after initial injury of femur involved by Paget's disease, June 7, 1947. b, 6 months after insertion of intramedullary nail, August 4, 1947. c, 9 months after insertion of intramedullary nail, March 8, 1948.

On May 7, 1947, showed evidence of callus formation around the subtrochanteric fracture of the left femur. The patient's right lower extremity was then placed in a long-leg cast for immobilization of the fracture of the tibia and fibula. On June 11, 1947, some drainage was noticed extending around the Steinmann pin which had been placed for traction through the left femur. While being returned to the ward after having roentgenograms taken, the patient twisted his left hip and felt a snap in the area of the subtrochanteric fracture of the left femur. Examination revealed a re-fracture through the previous fracture site. It was then decided to perform an internal fixation of the left femur and on June 10, 1947, open reduction at the fracture site was performed under spinal anesthesia. A Kuntscher type nail was inserted into the left femur, fixing the fracture adequately. A biopsy of bone was taken from the fracture site which showed bone compatible with Paget's disease. Following this operative procedure the patient's course was uncomplicated. The relief of pain after internal fixation was immediate and the patient was quite comfortable. He was discharged on the 17th day following insertion of the Kuntscher nail, the right lower extremity having been incorporated in a long-leg cast for immobilization of the fractures of the tibia and fibula.

The patient was seen again on August 1, 1947, at which time there was minimal evidence of callus formation around the subtrochanteric fracture of the left femur. Another follow-up roentgenogram on



Fig. 4. Case 4. a, Multiple myeloma with pathologic fracture of femur, June 20, 1947. b, after insertion of intramedullary nail, July 8, 1947.

October 14, 1947, showed considerable callus formation at the subtrochanteric fracture, but the fracture line itself was still clearly visible. The compounded injury of the right lower leg at that time revealed some drainage and roentgenograms showed no evidence of bony union. On December 2, 1947, a roentgenogram of the left femur showed callus formation over the medial aspect with evidence of healing at the fracture site. There was still absence of good bony healing of the right lower extremity. On March 8, 1948, a roentgenogram of the left femur showed union of the pathologic fracture of the femur but the fracture line was still clearly visible over the lateral half of the shaft. Roentgenograms of the right lower extremity showed union of the fracture of the fibula and early bridging callus between the tibial fragments with a sequestrum at the tibial fracture site. The sequestrum was subsequently removed. At that time the patient had become ambulatory, using crutches for ambulation and bearing full weight on his left femur.

CASE 4. C. C., a 66-year-old woman, had been followed by the orthopedic service since January 1944, with the diagnosis of far advanced generalized rheumatoid arthritis. She showed evidence of generalized osteoporosis and also had a spondylolisthesis of the fourth lumbar vertebra on the fifth lumbar vertebra. She was admitted to the surgical service on June 20, 1947, stating that on the previous day while attempting to get out of a chair, the right thigh suddenly collapsed and she fell backward into the chair. She felt a pain in the region of her right hip and there was complete loss of use of her right lower extremity.

Examination of the patient on admission showed far advanced generalized rheumatoid arthritis with



Fig. 5. Case 5. a, Pathologic fracture of femur involved by Paget's disease, October 7 1947; b, after insertion of intramedullary nail, October 9 1947; c, 3 months after insertion of intramedullary nail, January 5 1948.

deformed joints and marked contracture deformities of the hands, feet, knees, elbows and spine. Inspection of the right lower extremity revealed swelling and valgus deformity just below the region of the hip and some internal rotation of the distal part of the femur and leg. Roentgenograms showed a transverse fracture in the upper half of the right femur below the lesser trochanter which had the appearance of a pathologic fracture. Roentgenograms of the patient's skull showed multiple rarefied areas of the skull bones.

On July 5 1947 under nitrous oxide and pentothal anesthesia, an open reduction and introduction of an intramedullary nail into the right femur was performed. The entire cortex of the femur was extremely osteoporotic and destroyed by a neoplastic process. The operative procedure was uneventful. Biopsy of tissue from the site of the fracture was taken which proved to be plasma cell type of multiple myeloma. The patient developed fever on the 2nd postoperative day but on the following day the temperature returned to normal levels. The remaining postoperative course was uneventful. The patient was quite comfortable and pain free as far as the fracture was concerned. She was discharged on the 14th postoperative day.

A follow up letter for information told of the patient's death on December 4 1947 six months after the pathologic fracture had occurred.

CASE 5 R.B. a 71 year old man was admitted to the surgical service on October 7 1947 with the complaint of a fractured left thigh of 1 week's duration. He stated that approximately 1 week before admission while slowly walking around a table he suddenly felt a snap in the region of his left hip which was followed by severe pain and loss of func-

tion of the left lower extremity. Roentgenograms taken in his local hospital revealed a fracture of the left femur. He was treated there by traction.

Examination on admission here showed a well developed and nourished man not in acute distress. His abdomen was somewhat distended and tympanic. There was marked external rotation of the left lower extremity below the level of the upper thigh. There was minimal ecchymosis about the region of the left hip anteriorly. Roentgenograms of the region of the left hip and left femur in anteroposterior and lateral views showed coarsening of the trabeculae of the bone with thickening of the cortex indicative of Paget's disease. There was a transverse fracture in the subtrochanteric region with shortening and posterior displacement of the distal fragment.

On October 9 1947 under nitrous oxide and pentothal anesthesia open reduction and insertion of a Kneetscher type nail was carried out. A biopsy of the bone at the fracture site showed sclerotic bone consistent with Paget's disease. The operative procedure was uneventful and the patient's postoperative course was afebrile. The patient reported immediate relief of pain at the fracture site. He was able to be up in a chair 2 days postoperatively and was able to raise his leg off the bed with ease and without limitation of motion at the hip or knee joints. He was discharged on the 13th postoperative day.

The patient was seen again on January 5 1948. The left lower extremity showed free motion of the hip and knee joints and there was no tenderness over the area of the fracture. Roentgenograms of the left femur showed marked callus formation around the fracture site and evidence of healing. The patient



Fig. 6. Case 6, a, Carcinoma of breast metastatic in femur June 6, 1944 b, fracture through area of metastatic bone involvement October 1, 1947 c, after insertion of intramedullary nail, October 6, 1947 d, six months after insertion of intramedullary nail, November 4, 1947

returned again on April 9, 1948 at which time he was ambulatory. Roentgenograms revealed the fracture to have healed.

Case 6 G.G. a 30 year old woman was first seen in this hospital on June 6, 1944 with the complaint of pain in her thigh and lower back of approximately 6 month duration. Physical examination showed a primary neoplastic mass in her right breast with axillary metastases. Roentgenograms showed metastasis to the lumbar spine, pelvis, upper end of the right femur and upper half of the left femur. Since that time the patient had received intensive irradiation therapy with considerable improvement enabling her to carry on her usual occupation.

The patient returned on October 11, 1947 stating that the left leg had spontaneously collapsed and she had fallen. On admission shortly after the accident, the patient appeared emaciated, pale and somewhat older than her stated age of 30. Over the upper portion of her right breast a hard fixed irregular mass was present and there were numerous hard fixed metastatic lymph nodes in the right axilla. Examination of the left lower extremity showed a fracture deformity of the thigh with point tenderness and local swelling. Roentgenograms showed a pathologic fracture of the upper third of the left femur through the known metastatic area involving the bone.

On October 13, 1948, under nitrous oxide and general anesthesia an open reduction was performed at the fracture site and a Kuentzner type nail was inserted. A biopsy taken from the neoplastic tissue at the fracture site showed a leiomyosarcoma in bone. The operative procedure was uneventful.

There was immediate relief of pain at the fracture site. Roentgenograms showed the nail in satisfactory position with good alignment of the fragments.

The patient's course in the hospital was complicated by a pathologic fracture through the right upper humerus which occurred on the 5th postoperative day while she was turning in bed. This fracture, however, was not displaced. The patient was able to move her left lower extremity freely and without pain following the operative procedure. She was placed on testosterone propionate therapy and discharged on the 17th postoperative day.

Follow-up roentgenograms on November 14, 1947 showed some evidence of healing of the pathologic fracture of the left femur.

The patient expired at her home on February 7, 1948 four months after the introduction of the intramedullary nail.

Case 7 H.D., a 75 year old man was admitted to the surgical service January 20, 1948, complaining of a fractured right thigh of 1 week duration. He stated that for many years his right leg had been "weak" and he had suffered some discomfort in the thigh. About 1 week before admission while suddenly turning around, his right thigh buckled under him and he fell to the ground. There was considerable pain and swelling following this injury.

Physical examination on admission showed a 75 year old man who was obviously undernourished, dehydrated and somewhat disoriented. Examination of the right lower extremity showed a point of false motion at the junction of the upper and middle one-thirds of the femur with internal rotation of the

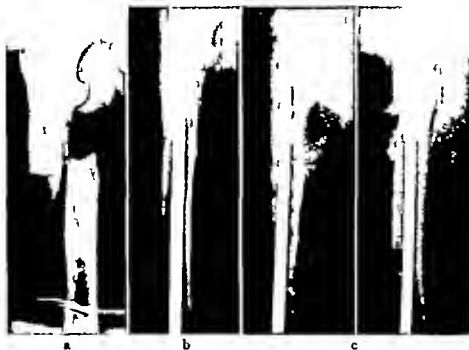


Fig. 7. Case 7. a, Pathologic fracture through femur involved by Paget's disease, January 29, 1948, b, after insertion of intramedullary nail, February 4, 1948, c, 3 months after insertion of intramedullary nail, May 10, 1948.

distal portion of the leg. There was considerable soft tissue swelling around the site of fracture and some muscle spasm. Roentgenograms taken on admission showed a complete transverse fracture of the femur at the junction of the proximal and middle one thirds with posteromedial displacement of the distal fragment. The proximal femur including most of the intertrochanteric area and a portion of the femoral neck showed an over-all increase in width of the shaft, generalized thickening of the cortex and definite coarsening of the bony trabeculae. The bony changes were those of Paget's disease. These changes extended distally to include the fracture area, although the change there was not as striking as in the proximal portion of the femur. The impression was Paget's disease of the right femur with pathologic fracture at junction of proximal and middle thirds.

On January 30, 1948, open reduction at the fracture site and insertion of a Kuentscher type nail was performed under spinal anesthesia. Roentgenograms taken postoperatively showed the intramedullary nail in place with good approximation and alignment of the fragments. The patient's postoperative course was uneventful except for periods of disorientation. He was able to sit up in a chair on the 3rd postoperative day and was discharged from the hospital on the 17th postoperative day.

The patient returned for examination on May 10, 1948. Roentgenograms showed the fracture to have healed. There was full range of motion of the hip and knee joints and the patient was ambulatory.

CASE 8. E.B., a 76 year old woman had been seen in this hospital intermittently since June 1947 with the diagnosis of carcinoma of the left breast with widespread osseous metastases. She had inten-

sive treatment with testosterone propionate with remarkable relief of pain and regression of all bony lesions. She was admitted to the surgical service on February 18, 1948, stating that 2 days before admission while walking in her bathroom with the aid of



Fig. 8. Case 8. a, Pathologic fracture secondary to metastatic carcinoma of breast, February 18, 1948, b, after insertion of intramedullary nail, February 20, 1948.



Fig. 6. Case 6. a, Carcinoma of breast metastatic in femur June 6, 1944; b, fracture through area of metastatic bone involvement October 11, 1947; c, after insertion of intramedullary nail October 6, 1947; d, one month after insertion of intramedullary nail, November 4, 1947.

returned again on April 9, 1948 at which time he was ambulatory and roentgenograms revealed the fracture to have healed.

Case 6. G. G., a 30-year-old woman, was first seen in this hospital on June 6, 1944, with the complaint of pain in her thigh and a lump of approximately 6 months duration. Physical examination revealed a primary neoplastic mass in her right breast with axillary metastasis. Roentgenograms showed metastasis to the lumbar spine, pelvis, upper end of the right femur and upper half of the left femur. Since that time the patient had received intensive irradiation therapy with considerable improvement enabling her to carry on her usual occupation.

The patient returned on October 11, 1947, stating that the left leg had spontaneously collapsed and she had fallen. On admission shortly after the accident the patient appeared emaciated, pale, and somewhat older than her stated age of 30. Over the upper portion of her right breast a hard, fixed, irregular mass was present and there were numerous hard, fixed metastatic lymph nodes in the right axilla. Examination of the left lower extremity showed a fracture deformity of the thigh with point tenderness and local swelling. Roentgenograms showed a pathologic fracture of the upper third of the left femur through the known metastatic area involving the bone.

On October 13, 1948, under nitrous oxide and pentothal anesthesia, an open reduction was performed at the fracture site and a Kuntsche type nail was inserted. A biopsy taken from the neoplastic tissue at the fracture site showed adenocarcinoma in bone. The operative procedure was uneventful.

There was immediate relief of pain at the fracture site. Roentgenograms showed the nail in satisfactory position with good alignment of the fragments.

The patient's course in the hospital was complicated by a pathologic fracture through the right upper humerus which occurred on the 5th postoperative day while she was sitting in bed. This fracture, however, was not displaced. The patient was able to move her left lower extremity freely and without pain following the operative procedure. She was placed on testosterone propionate therapy and discharged on the 17th postoperative day.

Follow-up roentgenograms on November 14, 1947, showed some evidence of healing of the pathologic fracture of the left femur.

The patient expired at her home on February 7, 1948, four months after the introduction of the intramedullary nail.

Case 7. I. L. D., a 75-year-old man, was admitted to the surgical service January 20, 1948, complaining of a fractured right thigh of 2 weeks' duration. He stated that for many years his right leg had been "weak" and he had suffered some discomfort in the thigh. About 2 weeks before admission while endeavoring to turn around, his right thigh buckled under him and he fell to the ground. There was considerable pain and swelling following this injury.

Physical examination on admission showed a 75-year-old man who was obviously undernourished, dehydrated, and somewhat disoriented. Examination of the right lower extremity showed a point of flexion motion at the junction of the upper and middle one thirds of the femur with internal rotation of the

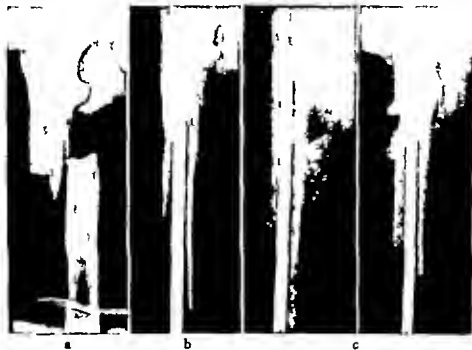


Fig. 7. Case 7. a, Pathologic fracture through femur involved by Paget's disease, January 20, 1948, b, after insertion of intramedullary nail, February 4, 1948, c, 3 months after insertion of intramedullary nail, May 10, 1948.

distal portion of the leg. There was considerable soft tissue swelling around the site of fracture and some muscle spasm. Roentgenograms taken on admission showed a complete transverse fracture of the femur at the junction of the proximal and middle one-thirds with posteromedial displacement of the distal fragment. The proximal femur including most of the intertrochanteric area and a portion of the femoral neck showed an over-all increase in width of the shaft, generalized thickening of the cortex and definite coarsening of the bony trabeculae. The bony changes were those of Paget's disease. These changes extended distally to include the fracture area although the change there was not as striking as in the proximal portion of the femur. The impression was Paget's disease of the right femur with pathologic fracture at junction of proximal and middle thirds.

On January 30, 1948, open reduction at the fracture site and insertion of a Kuntscher type nail was performed under spinal anesthesia. Roentgenograms taken postoperatively showed the intramedullary nail in place with good approximation and alignment of the fragments. The patient's postoperative course was uneventful except for periods of disorientation. He was able to sit up in a chair on the 3rd postoperative day and was discharged from the hospital on the 17th postoperative day.

The patient returned for examination on May 10, 1948. Roentgenograms showed the fracture to have healed. There was full range of motion of the hip and knee joints and the patient was ambulatory.

CASE 8. E.B. a 76 year old woman had been seen in this hospital intermittently since June, 1947, with the diagnosis of carcinoma of the left breast with widespread osseous metastases. She had inten-

sive treatment with testosterone propionate with remarkable relief of pain and regression of all bony lesions. She was admitted to the surgical service on February 18, 1948, stating that a day before admission while walking in her bathroom with the aid of

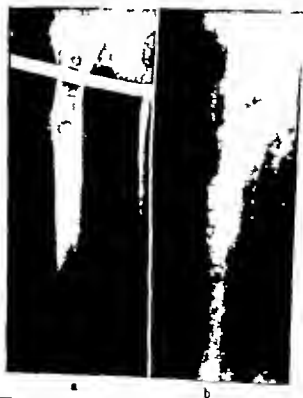


Fig. 8. Case 8. a, Pathologic fracture secondary to metastatic carcinoma of breast, February 18, 1948, b, after insertion of intramedullary nail, February 20, 1948.



Fig. 9. Case 9. a, Carcinoma of breast. b, Pathologic fracture of femur of 5 months' duration, March 8, 1948. b, after insertion of intramedullary nail March 20, 1948.



Fig. 10. a, Pathologic fracture of femur and metastatic hypernephroma, April 1, 1948. b, after insertion of intramedullary nail, April 24, 1948.

a came her right leg suddenly buckled and she fell.

Physical examination on admission showed an obese woman apparently not in acute distress. There was striking hirsutism of the face. Her voice was deep. The left breast was larger than the right. The nipple was retracted. There was orange-peel type of skin over the entire lower portion of the left breast, overlying a hard immobile nontender mass. Examination of the right lower extremity which was immobilized in Thomas splint traction showed some swelling and pain on pressure in the region of the mid-shaft of the femur. Roentgenograms of the pelvis and right femur revealed extensive neoplastic metastasis to the pelvis and femur with pathologic fracture of the right femur about 2 centimeters below the lesser trochanter.

On February 20, 1948, under nitrous oxide and pentothal anesthesia open reduction and insertion of an intramedullary nail was performed. A biopsy taken from the tissue at the fracture showed poorly differentiated metastatic carcinoma in bone. The patient's postoperative course was quite uneventful. Roentgenograms postoperatively showed the fragments of the pathologic fracture of the femur to be in excellent position and alignment. The relief of pain was remarkable. The patient was discharged from the hospital on the 13th postoperative day.

CASE 9. G.R., a 67 year old woman was first admitted to the surgical service on June 17, 1946, with the diagnosis of carcinoma of the left breast and axillary metastasis. A radical mastectomy was performed. During October, 1946 she developed severe pain in the upper right thigh. Roentgenograms at that time revealed an early destructive lesion in the

upper right femur approximately 3 inches below the lesser trochanter. The patient was treated with testosterone propionate but there was continued progression of the lesion. On October 18, 1947 the patient suffered a pathologic fracture through the involved area. Roentgenograms at that time showed a transverse fracture through the middle of the femur, with a small area in the upper one third of the right femur. The patient was placed in a hip spica cast. Many follow-up roentgenograms failed to show any callus formation or healing of the pathologic fracture.

The patient spent 5 months in a cast until March 20, 1948, at which time diamond shaped Hanes Street<sup>1</sup> intramedullary nail was inserted and an open reduction was done at the fracture site. The operative procedure was carried out under nitrous oxide and pentothal anesthesia. A biopsy taken from the area of involvement showed poorly differentiated adenocarcinoma in scar tissue. The postoperative course was quite uneventful and the patient was able to move her leg within a few days following the operation and was able to get up into a chair. She was completely free of pain and was discharged from the hospital on the 16th postoperative day.

CASE 10. J.H., a 65 year old man was admitted to the hospital on April 21, 1948. He stated that he had been perfectly well until about 6 weeks before admission, at which time he noticed some pain in the right thigh and leg. This pain increased in severity but he was able to walk and pursue his usual activity. On April 20, 1948 while walking on his porch, his right leg suddenly buckled under him and he fell. Roentgenograms at the local hospital revealed a fracture through the upper portion of the right femur.

Physical examination on admission showed a well developed and well nourished white male not appearing acutely ill. Heart and lungs were normal to percussion and auscultation. No abdominal masses could be felt. Inspection of the right lower extremity which was immobilized in a Thomas splint at the time of admission showed some angulation and swelling in the upper portion of the thigh. Roentgenograms revealed a transverse fracture through the subtrochanteric region of the right femur the fracture line running through an area of decreased density representing an osteolytic metastatic lesion. Other osteolytic metastatic lesions were seen in the tuberosity of the right ischium, in the right ilium and in the left parietal region of the skull.

On April 23, 1948 an open reduction was performed and an intramedullary nail of the Hansen Street type was inserted into the right femur under spinal anesthesia. A biopsy was taken during the time of the open reduction. Sections from this biopsy showed metastatic hypernephroma. The operative procedure was uneventful and the patient's postoperative course was afebrile. He was able to lift his leg without undue pain on the 2nd day following the surgical procedure. He was up in a chair 48 hours after the intramedullary nail had been inserted. Postoperative roentgenograms showed the intramedullary nail in place with excellent alignment of the fragments at the site of fracture. Retrograde and intravenous pyelograms showed the primary neoplasm to be in the left kidney. The patient was permitted to walk with the aid of crutches on the 5th postoperative day. He was discharged on the 10th day, completely pain free and ambulatory with the aid of crutches.

#### DISCUSSION

We have reported 10 cases of pathologic fracture of the femur treated by fixation with an intramedullary nail. Of the fractures reported 4 were due to Paget's disease, 5 to metastatic carcinoma and 1 to multiple myeloma. There is no evidence from this small series that dissemination of the tumor was hastened in the patients with metastatic carcinoma or that the terminal course of the disease was unfavorably influenced. In the 4 cases of Paget's disease a solid union occurred within a period of approximately 4 months.

In each instance immediate relief of pain at the fracture site was striking. No patient required external immobilization. All patients were placed upon a Boehler frame for a few days to effect elevation and temporary immobilization of the extremity. In no instance was the postoperative course complicated by wound infection, shock, hemorrhage or fat embolism. Special nursing care of the type re-

quired for conventional skeletal traction or cast cases was not necessary. The average period of hospitalization following introduction of the nail was only 2 weeks. Because of slight bending of the tubular type nail in 2 instances (one in this series and another in fixation of a simple fracture) we have abandoned the use of this type nail and have substituted the solid diamond shaped Hansen Street nail for femoral fractures (8).

In our experience healing is facilitated by this method not only under the abnormal conditions of pathologic fracture but is aided also in other fractures where unusual conditions are present such as those imposed by poor general condition of the patient and unfavorable local conditions (e.g. long standing non union with sclerosis of the medullary cavity). We have found that a number of such fractures have healed when ordinarily one would not have anticipated such a result. Where nonunion has occurred we have been able to use the intramedullary nail in conjunction with on lay bone grafts with early healing and satisfactory function of the extremity (9).

#### SUMMARY

This is a report of 10 cases of pathologic fracture of the shaft of the femur 4 of which were due to Paget's disease, 5 to metastatic carcinoma and 1 to multiple myeloma which were treated by intramedullary nailing.

The intramedullary nail fixation was followed by early relief of pain, free mobility of the extremity, reduction in the amount of nursing care and a decreased period of hospitalization.

In the cases of Paget's disease early healing was effected and early ambulation attained.

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# PROLONGED SPINAL ANESTHESIA USE OF INTRATHECAL VASOCONSTRICTOR SUBSTANCES

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THE many advantages of spinal anesthesia for all surgery below the diaphragm and including the lower extremities are well known and widely accepted. In the past, the chief disadvantage has been the unpredictable time element. Despite its obvious advantage to the surgeon in particular complete muscular relaxation the short and uncertain duration of anesthesia has prevented its wider acceptance. The purpose of this paper will be to demonstrate a means whereby with reasonable certainty and safety anesthesia with complete muscular relaxation can be obtained and maintained even in the upper abdomen for periods averaging over 3½ hours with a single intrathecal installation.

There have been many attempts in the past to prolong spinal anesthesia. These developments have resolved themselves into three approaches, namely (1) the use of different anesthetic agents or combinations of them (2) the use of repeated injections of the same agent (fractional spinal anesthesia) (3) the use of vasoconstrictor drugs intrathecally.

In 1898 August Bier of Bonn Germany who is recognized as the real father of spinal anesthesia, used, or rather had used on himself the first spinal anesthetic: a cubic centimeter of 1 per cent solution of cocaine (20 mgm) was injected into his subarachnoid space by an assistant. Satisfactory anesthesia was reported with a mild headache as the only sequela. Rudolph Matas published the first account of the use of a spinal anesthetic in the United States. In 1904 Fourneau introduced stovaine and Babcock popularized its use in this country. Procaine (novocain) was introduced by Einhorn in 1905. In 1907 the gravity control method was described independently by Barker and Chaput. In recent years pro-

caine (novocain) dibucaine (nupercaine) tetracaine (pontocaine) and piperocaine (L A 33 or metycaine) have been the potent substances most generally used. Procaine has, in the therapeutic doses usually used, produced satisfactory anesthesia with a minimum of toxic effect but in most hands, as in ours, its action has been of short duration. Metycaine and pontocaine, although longer acting have generally proved somewhat more toxic in the amounts usually employed. Nupercaine, although the longest acting is among the most toxic and even in competent hands has occasionally given rise to serious and fatal complications.

Many combinations of the various anesthetic agents have been tried and reports in the literature imply that there has been definite prolongation. Romberger in 1931 stated that a mixture of 5 to 7½ milligrams of nupercaine with 150 to 200 milligrams of procaine would give an anesthesia lasting from 2½ to 3 hours. Lewis in 1944 reporting on 300 cases, showed the average duration of such an anesthetic to be 115 minutes. His longest recorded time interval for anesthesia was 3 hours and 5 minutes, by using 3 to 8 milligrams of nupercaine with 50 to 100 milligrams of procaine.

The work of Lemmon in 1940 immediately opened a new vista. At last the time element could be so regulated that the surgeon could complete prolonged operations and close abdominal incisions under perfect muscular relaxation with the bowel still collapsed. With the fractional method the anesthetic agent could be administered in divided smaller dosage with significant reduction in toxicity. This was found to be of particular importance in poor risk patients.

Unfortunately however the use of fractional spinal anesthesia whether by malleable needle or indwelling catheter is not a simple

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procedure. It calls for more complex equipment. In addition a special table surface is required unless a catheter is introduced into the subarachnoid space. This is uncertain at best and often difficult. In clinics and hospitals with large and expertly trained staffs specializing in anesthesia this method can be depended on to produce satisfactory anesthesia in approximately 90 per cent of cases attempted but its complexities are such that it is rarely used in the smaller hospitals or clinics and certainly not in those situations in which the surgeon must of necessity give the anesthetic and then depend upon relatively untrained personnel to administer further doses at appropriate times.

While general attention has not been attracted to the use of intrathecal vasoconstrictor agents as a means of prolonging spinal anesthesia until very recently this is not a new procedure. In 1905 Heineke and Lawen reported the use of novocain adrenalin solution without ill effect. In 1911 Richards reported the use of suprarenin borate with procaine and normal saline solution. In 1943 Romberger quoted Hertzler as stating in an extemporaneous speech in 1934 that he had used intra spinal epinephrine for a good many years to prolong the effect of the anesthetic. Romberger in recalling his techniques in administering spinal anesthetics stated that in 108 cases he had used  $\frac{1}{2}$  to  $\frac{3}{4}$  cubic centimeter of a 5 per cent ephedrine solution and obtained 40 to 50 per cent longer duration of anesthesia. In 131 cases in which he used a 1:40,000 up to 1:120,000 dilution of adrenalin he reduced the amount of procaine necessary 25 per cent and prolonged the anesthesia from 100 to 150 per cent. One patient had motor relaxation for  $2\frac{1}{2}$  hours and sensory anesthesia for  $3\frac{3}{4}$  hours. Pitkin in 1939 advocated the use of a nonoxidizing epinephrine with subarachnoid capacity control. With this new solution plus 300 milligrams of novocain he reported anesthesia in the upper abdomen for 2 to  $2\frac{1}{2}$  hours and with 200 milligrams of novocain anesthesia in the lower abdomen for 3 hours. When pontocaine was used similarly, 20 milligrams produced anesthesia in the upper abdomen for  $2\frac{1}{2}$  to 3 hours, in the lower abdomen 4 to 5 hours and in the perineal region 5

hours. Prickett, Cullen and Gross in 1945 reported 108 cases in which they used procaine and epinephrine in dilutions of 1:30,000 and 1:100,000 with a definite prolongation of the anesthesia. Shane and Ruiz in 1945 reported 200 cases in which pontocaine-glucose solutions containing 0.2 cubic centimeter of 1:1,000 epinephrine prolonged anesthesia with less anesthetic agent required. They stated that other vasoconstrictors (methedrine, neosynephrine and ephedrine) were used, but did not prove as effectual as epinephrine.

Whitacre and Potter in 1948 reported the use of epinephrine or ephedrine both with pontocaine or nupercaine intrathecally. The anesthetic effect of pontocaine and dextrose was not altered by the addition of epinephrine but with ephedrine there was a 20 per cent increase in duration with a concomitant 30 per cent decrease in the amount of the drug necessary to produce comparable anesthesia. Conversely a hypobaric nupercaine-epinephrine solution produced an increased anesthetic effect but a hypobaric nupercaine-ephedrine solution did not give significant results. From the foregoing it can be seen that many contradictory and conflicting claims have been made in the distant and recent past.

Continuous spinal anesthesia was introduced in this hospital in 1945 by one of the authors nevertheless in spite of careful adherence to detail an appreciable number of patients still occasionally failed to get and often to maintain a high and adequate anesthesia. Unfortunately also more than twice as much time was needed to administer the initial anesthetic dose by this method than by the so-called 'one shot spinal'. In an effort to obtain the same advantages inherent in the fractional spinal anesthetic and at the same time to abolish its complexities and uncertainties one of the authors began the intrathecal use of epinephrine and ephedrine in 1946 with fairly good results. At that time however it was felt that some other agent with more uniform action was desired and that after investigation of its physiologic and pharmacologic characteristics phenylephrine hydrochloride neosynephrin should be given a trial. It was used several times intrathecally in 10 milligram amounts with satisfactory results.

# PROLONGED SPINAL ANESTHESIA USE OF INTRATHECAL VASOCONSTRICTOR SUBSTANCES

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THE many advantages of spinal anesthesia for all surgery below the diaphragm and including the lower extremities are well known and widely accepted. In the past, the chief disadvantage has been the unpredictable time element. Despite its obvious advantage to the surgeon in particular complete muscular relaxation the short and uncertain duration of anesthesia has prevented its wider acceptance. The purpose of this paper will be to demonstrate a means whereby with reasonable certainty and safety anesthesia with complete muscular relaxation can be obtained and maintained, even in the upper abdomen for periods averaging over 3½ hours with a single intrathecal installation.

There have been many attempts in the past to prolong spinal anesthesia. These developments have resolved themselves into three approaches namely (1) the use of different anesthetic agents or combinations of them (2) the use of repeated injections of the same agent (fractional spinal anesthesia) (3) the use of vasoconstrictor drugs intrathecally.

In 1898 August Bier of Bonn Germany who is recognized as the real father of spinal anesthesia, used or rather had used on himself the first spinal anesthetic 2 cubic centimeters of 1 per cent solution of cocaine (20 mgm) was injected into his subarachnoid space by an assistant. Satisfactory anesthesia was reported with a mild headache as the only sequela. Randolph Matas published the first account of the use of a spinal anesthetic in the United States. In 1904 Fournneau introduced stavaine and Babcock popularized its use in this country. Procaine (novocain) was introduced by Einhorn in 1905. In 1907 the gravity control method was described independently by Barker and Chaput. In recent years pro-

caine (novocain) dibucaine (nupercaine) tetracaine (pontocaine) and piperocaine (L A 33 or metycaine) have been the potent substances most generally used. Procaine has, in the therapeutic doses usually used, produced satisfactory anesthesia with a minimum of toxic effect but in most hands, as in ours, its action has been of short duration. Metycaine and pontocaine, although longer acting have generally proved somewhat more toxic in the amounts usually employed. Nupercaine, although the longest acting is among the most toxic and even in competent hands has occasionally given rise to serious and fatal complications.

Many combinations of the various anesthetic agents have been tried and reports in the literature imply that there has been definite prolongation. Romberger in 1931 stated that a mixture of 5 to 7½ milligrams of nupercaine with 150 to 200 milligrams of procaine would give an anesthesia lasting from 2½ to 3 hours. Lewis in 1944 reporting on 300 cases, showed the average duration of such an anesthetic to be 112 minutes. His longest recorded time interval for anesthesia was 3 hours and 5 minutes, by using 3 to 8 milligrams of nupercaine with 50 to 100 milligrams of procaine.

The work of Lemmon on fractional spinal anesthesia published in 1940 immediately opened a new vista. At last the time element could be so regulated that the surgeon could complete prolonged operations and close abdominal incisions under perfect muscular relaxation with the bowel still collapsed. With the fractional method the anesthetic agent could be administered in divided smaller dosage with significant reduction in toxicity. This was found to be of particular importance in poor risk patients.

Unfortunately however the use of fractional spinal anesthesia whether by malleable needle or indwelling catheter is not a simple

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checked until the desired level is reached. This level is initially determined by pricking the patient's skin at the shoulder level and then starting similar pricks on the thigh and moving upward until the pinprick is as sharp as at the shoulder level. This is repeated on the opposite side and the sides checked continually watching the level rise to the desired dermatome after which the table is leveled off from its former Trendelenburg position. Only now may the acute flexion of the neck be dropped. It should be emphasized that to obtain the proper anesthetic level with good muscular relaxation the pinpricks should delineate the anesthetic, not the hypesthetic zone which is a spread or diffusion effect of approximately one dermatome breadth. The sharply flexed neck has in every instance prevented a rise in anesthesia beyond the 1st to 2nd thoracic segment. In our hands there has been no further extension of anesthesia after the initial 10 to 12 minutes either adventitiously or on the deliberate attempt of the surgical staff. This fixation has not been affected by the use of neosynephrin and points to its possible mode of action namely delaying the removal and/or oxidation of the anesthetic agent from the nerve roots. This is accomplished by limiting the access and egress of blood to and from this area rather than by delaying absorption of the anesthetic drug by the nerve root. Accordingly once fixed there is no contraindication to the Trendelenburg or reverse Trendelenburg positions.

The level usually obtained for upper abdominal surgery is the 3rd thoracic segment, the 5th thoracic for lower abdominal surgery, the 6th thoracic for hernioplasty and 7th to 8th thoracic for lower extremity and proctologic-perineal surgery. A graphic dermatome chart is maintained in the anesthesia book to be constantly available for reference. A most helpful maneuver is to ask the patient to raise his head and neck. If the upper recti fail to contract, the level of the anesthesia is above the 6th thoracic and abdominal surgery can be done without pain and with good muscular relaxation.

**Anesthetist** The deliberate use of 12 members of the surgical staff and 12 interns as anesthetists excludes the single expert anesthetist

from consideration as a factor influencing the results.

**Amount of vasoconstrictor agent** To control this study properly it was decided to apply the vasoconstrictor agent in both angle in injection and continuous spinal anesthesia. Both the type of drug and the amount of the anesthetic agent were allotted for various regions, as follows

	Mgm	
Rectal and perineal	50-100	Procaine
Hernioplasty unilateral	8	Pontocaine
Hernioplasty bilateral	10	Pontocaine
Lower extremity	10	Pontocaine
Lower abdominal	10	Pontocaine
Upper abdominal	12	Pontocaine

Since it was determined by the workers at the University of Utah that an optimum amount of neosynephrin was reached after which any further increase added nothing to the prolongation effect, and that this point was found to be approximately 5 milligrams it was arbitrarily decided to use 3 milligram amounts throughout this study in every instance. The pontocaine-glucose neosynephrin solutions are thoroughly mixed together in the syringe prior to injection.

**Continuous spinal anesthesia** This has been the choice for gastric resections and other similar procedures in which the time factor is in doubt at the start of the operation. It is also used in spinal fusions. The following formula has been adhered to

	Gastric resection	Spinal fusion
Glucose	4 c.c.	3 c.c.
Pontocaine	6 c.c. (60 mgm.)	4 c.c. (40 mgm.)
Neosynephrin	1½ c.c. (15 mgm.)	1 c.c. (10 mgm.)
Spinal fluid	8½ c.c.	5 3 c.c.
	30 c.c.	13 3 c.c.

Initially 4 cubic centimeters of this solution which contains 3 milligrams of pontocaine per cubic centimeter or a total of 12 milligrams of pontocaine and 3 milligrams of neosynephrin is injected after the patient has first been placed in a 30 to 40 degree Trendelenburg position with the neck acutely flexed.

Sectional hinged raised plywood forms have been devised at this hospital and are interchangeably fixed to the operating table tops so that an aperture exists over the area in the lumbar spine from which the malleable needle



orthopedic procedures from spinal fusion and bempelvectomy to open and closed reduction of fractures are covered. All the usual proctologic conditions are included.

**Experimental results** The one best criterion for any anesthetic is abolition of pain and maintenance of complete muscular relaxation for the duration of surgery. Based on this criterion in 1 000 cases excluding 1 per cent failures satisfactory anesthesia was maintained for the duration of surgery as indicated in Table I.

These figures represent only the time from establishment of anesthesia to the close of surgery and do not necessarily indicate the total duration of anesthesia. Actually when investigated as outlined on the basis of (1) appearance of pain at the site of incision (2) ability to move legs again, and (3) pain to pinprick at the dermatome level of the skin incision, the duration of anesthesia is much longer. Since the recorded average duration is so prolonged that it started even the authors no case was included in determining the final averages unless all its data had been completely recorded. This was true in the 655 cases divided by region and showing the average duration of anesthesia as represented in Table II.

Since this long duration of anesthesia was achieved with less than half the regularly accepted dosages of the anesthetic drugs, it was decided to analyze these cases by amount of drug used to discover the effect, if any, of increased dosage to the duration of anesthesia. The analysis bears out the clinical impression that as the amount of the anesthetic agent is increased the duration of anesthesia is extended.

#### COMPLICATIONS AND DISADVANTAGES

These results were recorded in the entire series of 1 000 cases. In every instance, except 10 satisfactory anesthesia was obtained a failure index of 1 per cent. In 6 of these the blood pressure rose sharply immediately following injection indicating a systemic effect from the vasoconstrictor substances. These patients usually complained of headache. This obviously represents absorption of the neosynephrin into the general circulation and

TABLE I—AVERAGE OPERATING TIME

Region	No. cases	Drug	Amount mgm.	Average time hr. min.
Rectal and perineal	114	Procaine	50-100	43
Lower extremity	150	Pontocaine	10	1 40
Hemiplegia	258	Pontocaine	8-10	1 32
Lower abdominal	299	Pontocaine	10	1 19
Upper abdominal				
Single Injection	93	Pontocaine	12	2 05
Continuous spinal	86	Pontocaine	19 g	4 08
Total	1,000	(average)		

conversely indicates that the anesthetic solution was not deposited intrathecally. No completely satisfactory explanation could be given for failure in the other 4 cases. In every instance a supplemental tap was done, clear spinal fluid withdrawn and sent to the laboratory for qualitative and quantitative determination of the anesthetic drug which was present in each instance and in quantities deemed adequate for anesthesia. In 1 of these cases local and regional infiltration with 1 per cent procaine hydrochloride was executed without anesthesia resulting even in the skin wheals. This robust individual required massive doses of pentothal in more than double the amounts usual for similar procedures.

Supplemental measures, usually toward the end of surgery were necessary in 56 cases or 5.6 per cent of the total. Intravenous morphine was used in 33 cases, pentothal in 17, cyclopropane in 3, nitrous oxide-pentothal in 1, and local infiltration with procaine in 2.

The disadvantage of nausea was present in 51 cases or 5.1 per cent. A considerable number of these patients experienced a fall in systolic blood pressure in the first 10 minutes following administration of the anesthetic. 100 per cent oxygen inhalations relieved this group in every instance. In a smaller per-

TABLE II.—DURATION OF ANESTHESIA FROM CLINICAL CRITERIA

Type of operation	No. cases	Pain appears		Able to move legs		Painful pin-prick same dermatome	
		hr.	min.	hr.	min.	hr.	min.
Rectal	86	3	40	2	37	3	18
Lower extremity	77	3	13	4	39	3	4
Hemiplegia	190	5	30	5	32	5	52
Lower abdominal	201	3	32	4	31	3	23
Upper abdominal							
Single Injection	47	6	13	5	40	6	0
Continuous spinal	54	7	33	8	14	7	31
Total	633						

head protrudes. This permits leading the special tubing to the side and thence to the head of the table where the anesthetist controls the syringe with the prepared solution. The lumbar tap is done from the lateral recumbent position the spinal fluid obtained mixed with the various agents, and with the patient supine in Trendelenburg position the solution is injected rapidly. The table is leveled to a 5 degree Trendelenburg and there maintained throughout the operation. Further fractional injections are given by the anesthetist so as to maintain muscular relaxation and permit surgery without discomfort to the patient. In every instance a light pentothal overlay is begun 2 hours after initial anesthesia to allay anxiety and provide physiologic rest for the remainder of the procedure. Surgical anesthesia has never been attempted with this drug and the amounts required throughout surgery are usually less than 1 gram.

#### STATISTICAL ANALYSIS

This study covers a series of 1,000 consecutive cases in which spinal anesthetics were used during the period from May 1947 through May 1948. The initial and most important criterion has been the maintenance of satisfactory anesthesia for the entire duration of surgery. In addition to maintenance of satisfactory anesthesia throughout the operation three additional points were selected in an attempt to establish further clinical criteria by which the duration of anesthesia could be assessed. The first of these criteria is the appearance of pain at the operative site. This definitely fixes the time that sensation returns to that dermatome level which includes the skin incision. Localization is more accurate in this hospital because transverse and oblique incisions are used exclusively. As the most reliable index of motor function (end of muscular relaxation) the ability to move both legs was chosen as the second criterion. To cross check on return of sensation and eliminate subjective factors, pain on pinprick at the dermatome level of the skin incision was introduced as the third criterion. These criteria were recorded by the interns and nurses on the various wards following the return of the patient from surgery.

Blood pressure and pulse rates were also determined prior to anesthesia and every 10 minutes for the first 30 minutes of anesthesia and again at the conclusion of the operation. Height of anesthesia was accurately determined in every instance by pinprick as already outlined and this level was recorded. A record was likewise made of the site of spinal puncture. The time of administration of the anesthetic, the time surgery was initiated and concluded were also recorded in every instance.

In a previous series in which over 2,000 spinal anesthetics were administered at the Seattle Marine Hospital and in which intrathecal vasoconstrictors were not used, the average duration of anesthesia was found to range from 100 minutes with 16 to 20 milligrams of pontocaine in the upper abdomen 70 minutes in the lower abdomen and inguinal area for 150 milligrams of procaine, to 55 minutes in the perineal area for 50 to 100 milligrams of procaine.

Maxon in this book *Spinal Anesthesia* lists the average duration of anesthesia for the usual dosage of procaine as 60 minutes, pontocaine as 90 to 120 minutes, and nupercaine as 2 to 4 hours. The duration of spinal anesthesia varies considerably with the individual case this despite rigid adherence to an identical technique in the hands of the same anesthetist. Maxon reports a spread from 55 to 90 minutes under identical circumstances. Vohrs reported variation from 12 minutes to more than 2 hours.

#### DIVERSITY OF SURGICAL MANEUVERS

The present series of 1,000 consecutive cases in which neosynephrin has been used intrathecally as a vasoconstrictor agent has been subdivided into the five categories already mentioned. In the upper abdomen all the common procedures and the more for midable such as total pancreatectomy are included with over 50 gastric resections in this group. In the middle and lower abdomen the range is from appendectomy to colectomy. The entire range of gynecologic and urologic surgery is represented. Five cesarean sections are included in obstetrics. Over 200 assorted hernias are included. Many difficult

cent of the series. The routine use of an indwelling catheter in the early postoperative period is practiced in bladder and prostatic surgery, abdominoperineal resection, vesicovaginoplasty and rectovaginoplasty, and also in panhysterectomy.

#### COMMENT

The authors do not offer their three additional criteria as proof that satisfactory surgical anesthesia will persist for this entire time and believe instead that the average safe interval for surgery lies approximately halfway between the average time in surgery and that recorded by these additional criteria. As such 3 to 3½ hours of surgical anesthesia can reasonably be expected for surgery of the upper abdomen from 12 milligrams of pontocaine combined with 3 milligrams of neosynephrin. This represents more than 100 per cent prolongation of anesthesia with a 50 per cent simultaneous reduction in the amount of drug used. Comparable results follow for the other regions. This should allow the average surgeon to use a single injection of a spinal anesthetic with a feeling of confidence in the duration of anesthesia and freedom from undesirable sequelae. Some individual variations can be expected in a small percentage of cases but such patients should usually respond to simple supplemental measures.

The unusually close average correlation of the two methods of determination of sensory return has been noted with interest. The slightly more rapid return of motor function was expected and proved true except in fractional spinal anesthesia where there was a uniform unexplained delay in its return.

In general it appears that to produce adequate high anesthesia, larger amounts of the potent drug must be introduced closer to the desired site of action (through a higher site of injection) and with a proportionally heavier solution. When this is done however a longer overall period of anesthesia results.

To the patient the 10 to 1 per cent of postpuncture headaches is the only disagreeable complication. Since at present the cause of 'postpuncture headache' is not understood,

it will be difficult to correct this factor but further studies on the relation of headache to the use of the glucose weighing vehicle are now in progress. In time these will be reported in an effort to arrive at the ideal combination of agents to prolong spinal anesthesia with a single injection.

#### CONCLUSIONS

1 This paper presents the technique used at the Seattle Marine Hospital in the administration of spinal anesthesia. It is used in all surgery below the diaphragm, the usual contraindications excepted.

2 A brief review of the literature of the various methods used by other workers in their attempts to prolong spinal anesthesia has been included.

3 The results over a 12 month period in 1,000 consecutive cases have been described.

4 No fatalities or permanent sequelae ensued.

5 Neosynephrin in 3 milligram doses when added intrathecally to the anesthetic agent safely prolongs the duration of spinal anesthesia over 100 per cent with a significant reduction in the amount of anesthetic agent required.

6 Three to 3½ hours of satisfactory surgical anesthesia in the upper abdomen can be achieved from a single injection of spinal anesthetic in over 90 per cent of all cases.

7 In continuous spinal anesthesia neosynephrin reduces the frequency of subsequent injections as well as the total amount of anesthetic agent necessary. This is of particular importance in poor risk patients.

8 The complications and disadvantages have been of extremely low incidence and have been discussed with an attempt to explain the reasons for their occurrence and precautions to be taken to avoid them in the future.

9 This method of anesthesia can be administered satisfactorily by the average surgeon. This should be of particular value to those surgeons who practice in the smaller hospitals.

10 Further investigation is in order to discover the ideal vasoconstrictor agent anesthetic agent, and combination thereof whereby



centage of the group nausea was evidenced when tension was made on the abdominal esophagus and disappeared when tension was released.

A drop in systolic blood pressure greater than 10 milligrams of mercury occurred in 92 cases (92%) in the first 10 minutes following administration of the anesthetic. In 3 instances ephedrine had not been administered subcutaneously and in this and 5 other instances 3 milligrams of neosynephrin was given for its systemic effect. In no other instance was any supplemental vasopressor drug used. It was most interesting to note that in approximately 75 per cent of the entire series the blood pressure level 30 minutes following anesthesia was significantly higher than that prior to anesthesia. It must be remembered that 50 milligrams of ephedrine was used uniformly at the time anesthesia was administered.

In this series there were no fatalities or neurologic complications. There were 4 instances of high spinal anesthesia indicating medullary involvement 1 of which was severe. This person was so heavily sedated that co-operation was difficult. It is believed that positioning following administration of the anesthetic mixture accounted for its subsequent level. Since his spine was to be explored for a lumbar disc herniation he was left in the lateral decubitus position the table dropped to 35 degree Trendelenburg and the neck flexed upward laterally. Actually the upward curve of the neck produced in the lateral projection was insufficient to stop the progression of the hyperbaric solution. Respiration and heart action were temporarily paralyzed. By bag resuscitation with an adequate airway compression bandaging of all extremities, the prompt removal of 60 cubic centimeters of spinal fluid, and forced rapid infusion of plasma and dextrose to restore blood volume the vital functions returned and the anesthetic level gradually receded. His subsequent recovery was complete. The other 3 persons responded immediately to less drastic measures. From that time on it has been the rule that all anesthesia levels, rectal and perineal cases excepted are to be established with the patient in the supine

position and only after fixation shall other positioning be done.

No serious or permanent sequelae resulted. Headache was the most common, almost the only complaint due to anesthesia recorded in the postoperative course and was noted in 101 cases or 10.1 per cent. It must be borne in mind, however that the surgical staff and nurses were alerted to its possible occurrence and instructed to record every instance in a special book. Symptoms were typical of the 'postpuncture type' with onset usually the second postoperative day inaugurated and aggravated by the erect position and relieved by recumbency. They ranged from mild to severe, most of them mild of 1 to 2 days' duration and not very troublesome. There were several however that lasted 7 to 10 days necessitating intravenous caffeine sodium benzoate and occasionally ergotamine tartrate intramuscularly. In this group there were 2 patients who complained of stiffness of the neck and evidenced nuchal rigidity indicative of meningismus of a mild and transitory nature. No specific treatment was required. It should be remembered that early ambulation (the first postoperative day in all cases) is maintained. This may have resulted in more headaches being noted than in institutions where recumbency is enforced.

Early ambulation however together with deep breathing exercises and frequent changes in position beginning immediately upon the return of the anesthetized patient to the ward, is in the opinion of the authors responsible for the unusually negligible incidence of pulmonary complications. In this entire series there were only 2 cases of massive atelectasis, both recognized and bronchoscoped the night of operation. Their recoveries were uneventful thereafter. There was only 1 instance of 'postoperative pneumonia'. There were no cases of fatal pulmonary infarction. Infarction of minor degree was recognized in 9 cases.

Contrary to popular opinion and quite likely influenced profoundly by early ambulation catheterization was performed in only 33 cases including the urological cases. In only 1 case was it necessary more than once. Male patients comprise approximately 93 per

cent of the series. The routine use of an indwelling catheter in the early postoperative period is practiced in bladder and prostatic surgery, abdominoperineal resection, vesicovaginoplasty and rectovaginoplasty, and also in panhysterectomy.

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all spinal anesthesia may be administered with one injection

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# EDITORIALS

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APRIL, 1949

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### THE VALUE OF RESPIRATORY FUNCTION STUDIES IN PULMONARY SURGERY

**S**TUDIES of various phases of respiratory function have played a significant role in the development of surgery of the lung. There has been a tendency for the surgeon to overlook the value of such investigations because special tests are not necessary in many patients submitted to pulmonary excision or collapse therapy. One tends to forget that our clinical evaluation of all cases has been indirectly influenced by the complete studies of pulmonary function which have been made in a few institutions.

Pulmonary tests have revealed a number of important facts. The surprising reduction in function which may result from the fixation of a relatively normal lung by a fibrous membrane over the pleura has been revealed. The unreliability of estimating function from the roentgen appearance of the lungs has become very evident. Fluoroscopic observations give more information, at least as far as ventilatory

factors are concerned. The importance of pulmonary emphysema in assessing the operative morbidity and mortality, and also in estimating the patient's breathing reserve after the postoperative period deserves wider recognition. It is through respiratory tests that we now know that overdistention of pulmonary tissue may interfere with function. These observations are the basis for the recommendation that thoracoplasty should follow pneumonectomy and occasionally even lobectomy in certain situations. The better functional adjustment which follows pulmonary resection in childhood as compared to adults has been demonstrated. The remarkable correlation between pulmonary ventilation and circulation has become manifest. These are but some things that have already been shown. Much additional data are highly desirable both in order to supply a more certain basis for the tentative conclusions which have already been arrived at and also for a critical review of clinical impressions from the physiologic standpoint.

In order to obtain the most help from a test designed to give information concerning the function of any organ, knowledge of the physiologic basis of that test is required. Since the function of organs is complex, a single test may give data about one factor only. Because disease processes may affect the different components of the respiratory mechanism in varying degree, no one test can be expected to elucidate the problem adequately. Yet the manner in which tests of pulmonary function are often utilized by the clinician indicates his failure to appreciate these facts.

From the physiological standpoint, pulmonary function can be divided into two categories

ries (1) ventilation or the mass displacement of air between the outside atmosphere and the interior of the lungs and (2) respiratory gas exchange, or the exchange of oxygen and carbon dioxide between the blood in the pulmonary capillaries and the air. It is obvious that these two are closely interrelated but various types of tests are necessary to obtain information concerning both components of pulmonary function<sup>1</sup>

Determination of vital capacity has frequently been employed as a single test of lung function without a realization of the meager information thus obtained. The vital capacity is the amount of air which can be displaced by the lung during a single maximum ventilatory effort. It does not take the factor of time into consideration nor does it give any information about the patient's ability to transport oxygen from the alveoli to the blood in the pulmonary capillaries. Clinical observation of a patient's response to exercise will sometimes give more reliable information than an estimate of the vital capacity alone. An emphysematous patient who is dyspneic may have a relatively good vital capacity. Although the patient with emphysema may displace considerable air during a single maximum effort, it may take so long to get gases into and out of the lungs, that the ventilatory efficiency is actually poor. An estimation of maximum breathing capacity which is the total amount of air which can be moved by the lungs in a series of maximal inspirations and expirations per unit of time, is a simple and better way to determine the ventilatory function of the lung.

If respiratory function studies are to aid in determining the operative risk one must know to what extent the operative procedure alters or reduces such functions. This means that the effects of the anesthesia, the possibilities

of transient hypoxia, alterations in cardiocirculatory function, the degree of respiratory depression and the effect of reflexes must all be taken into consideration. Therefore, the value of physiological tests in estimating operative risk is limited at present because operative procedures which may be standardized as far as surgical technique is concerned are not as well standardized for accompanying physiological disturbances. The physiologically minded surgeon will avoid certain pitfalls that others may fail to consider. It should be stressed that hypoxia is often present without obvious cyanosis, that significant circulatory changes may occur without alterations in blood pressure or pulse and that both anesthesiologist and surgeon are often not fully cognizant of somewhat inadequate respiratory function.

The results of tests must be assessed in relation to the alterations which will occur from the operative procedure. If the pulmonary reserve is low the amount of functioning lung tissue removed by the lobectomy or pneumonectomy will be of greatest importance. Removal of a collapsed, airless lobe may result in little change in pulmonary function. Occasionally the function is slightly better after resection because all the pulmonary circulation then goes through ventilating lung tissue. Naturally there will be a temporary reduction in function during the operative and postoperative period. If removal of considerable functioning pulmonary tissue is contemplated, tests indicating poor reserve may warn the surgeon to modify the operative procedure or advise against operation. Mandatory operations, such as those for cancer, justify lessening the degree of consideration to be given to tests which show poor pulmonary function.

The distribution of the respiratory function between the two lungs must be determined by bronchospirometry in some cases before an in-

<sup>1</sup>Goldstein, E. de F. Coetzee, A. and Richards, D. W. Jr. *Medicine*, 34:2, 171-183.

telligent recommendation can be given. This situation occurs most frequently in bilateral pulmonary tuberculosis. We may not be able to tell clinically and roentgenographically which lung is responsible for the greatest oxygen consumption. It may be found that although the total pulmonary function is fairly adequate, the side requiring collapse or excision is performing most of the respiratory function. In such a case the tests may save one from performing an operation which can only harm the patient even some cardiorespiratory deaths may thus be prevented.

The surgeon who was trained or works in an institution with a laboratory engaged in studies of respiratory function has a real opportunity. When tests of pulmonary function are performed on patients who are undergoing surgical treatment the physiological alterations which accompany disease and operative intervention are often clarified. If the surgeon is alert to his opportunities and constantly thinks along physiologic lines, the importance of many details in operative and postoperative care will become more and more evident as his knowledge and experience increases. The attitude that cardiorespiratory deaths following pulmonary or other surgery are in the majority unavoidable merely indicates a lack of knowledge. A failure to adjust accurately the intrapleural pressure after pneumonectomy, the acceptance of hypoxia during anesthesia, undue traction of the pulmonary hilum are but a few of the errors which are still made. The complications that the surgeon regards as not preventable are those whose mechanism of development he does not understand and therefore is unable to forestall. It would seem most desirable that adequate instruction in the clinical application of tests of pulmonary function be incorporated in the training of all those planning to perform intrathoracic operations.

Needless to say, much additional data should be obtained. At the present moment we are looking forward to further information concerning the function of the decorticated lung. We already know that a lung which appears well expanded following decortication may occasionally have poor function. The influence of long standing intrapulmonary disease and the duration of collapse must be evaluated. Also the pulmonary function after segmental resection requires more accurate appraisal. But probably most important of all is the need for data as to the physiologic disturbances which occur during operation. By this new knowledge the "unpreventable" complication of today may be avoided in the future.

HERBERT C. MAIER

## SIMPLICITY IN SURGERY

MOST students of medicine and many others who spent their college days in Philadelphia in the 1920's and 1930's were privileged to attend the Saturday afternoon clinics of Dr. John B. Deaver. Hardly anyone who attended that clinic can forget Doctor Deaver's motto "Cut well, sew well, get well." This simple formula can well be preached today. The majority of patients who are operated upon with adequate indications and on whom the technical portion of the operation is carried out with due respect for the physiology of the organs involved and with care of the tissues handled will get well with relatively few postoperative complications.

It is surprising however to find that most medical students and interns believe that any abdominal operation requires intubation of one sort or another that practically all patients operated upon over the age of 60 should be given some form of anticoagulation therapy or femoral vein ligation and that practically

all operations should be followed by a period of penicillin, if not of streptomycin therapy and often the combination of both. The practice of preventing complications which never occur or never should occur is so widespread that the preoperative and postoperative care of patients has become a complicated procedure for the residents and interns, and more important a most troublesome time for the patient.

Due to an attempt to set up a routine which will take care of every emergency many a patient is unnecessarily disturbed by procedures which are not warranted in his particular case. It would seem worth while to individualize the care of each patient based on the knowledge and understanding of his particular problem. In the preoperative care of patients undergoing gastric resection passage of a tube into the stomach to provide suction drainage is rarely necessary unless the patient has an obstruction of the pylorus. After operation the tube is unnecessary unless vomiting becomes a prominent symptom. In the short loop antecolic Hofmeister type of gastrojejunal anastomosis vomiting occurs very infrequently. We have rarely found it necessary to use gastric suction postoperatively and we have never encountered an indication for the use of double lumen tubes for simultaneous gastric suction and jejunal feeding. The patients are able to take fluids and food on the second or third postoperative day without difficulty. It would seem unnecessary under such circumstances to add to a gastric resection and gastrojejunal anastomosis a jejunostomy for feeding purposes. A patient with a properly placed and properly performed gastrojejunostomy will take and retain nourishment sufficient for

his caloric needs by the third or fourth post operative day. One patient operated upon recently for an obstructing pyloric lesion gained twelve pounds within the first ten days following his operation.

At the time of operation gentleness in the handling of tissues and careful hemostasis, ligating only the bleeding vessel with fine ligatures, aid much in the patient's convalescence. In the opinion of the writer the avoidance of all forms of crushing clamps is another factor which permits kindly healing and averts the traumatic edema which so greatly retards the tissues healing. This is true not only for operations in the upper intestinal tract but also for operations on the large and small bowel. Infections of the peritoneal cavity do not arise from contamination at the time of an open anastomosis if ordinary precautions are taken. Peritonitis from intestinal anastomosis arises from leakage at a suture line caused either by lack of attention to the blood supply or by an inadequate technique.

The advent of intestinal antiseptics and antibiotics has led to an unwarranted dependence upon these agents and to the disregard of the basic principles of surgical technique. It should be stressed that without an adequate basic technical procedure these substances are useless, and with an adequate technical procedure they usually are unnecessary.

This is written with no effort to decry the many valuable adjuncts to the care of the patient which are at our command. It is to emphasize however that the natural tendencies to repair and recovery function normally without much outside help. Most patients well operated upon will get well themselves, if they are allowed to! L. KRAZER FERGUSON

# THE SURGEON'S LIBRARY

## REVIEWS OF NEW BOOKS

THE volume *Sterility and Impaired Fertility*<sup>1</sup> a second edition is the result of collaboration by British specialists working in different parts of the field. They have succeeded in demonstrating the fact that both the etiological factors and therefore the therapeutic indications are distributed over a very wide field in which general medicine, gynecology, urology, endocrinology and psychology may all be involved. All the recent advances in seminology and reproductive physiology are included with special reference as to the interpretation and significance of postcoital tests and the more recently developed invasion tests as worked out by the authors. Details on the technique of semen analysis are clearly presented as are all the newer adjuncts to the determination of ovulation including cyclical temperature records. The presentation is directed primarily toward the general practitioner but should prove equally valuable to the gynecologist and the urologist. It is a comprehensive volume which in a most effective way combines a theoretical consideration of reproductive physiology with the practical application of the principles presented. The balance between theory and practice is well maintained although one gathers that the authors are more enthusiastic over endocrine therapy and x ray therapy than most groups in America. All in all however this is a very useful and complete volume on a very common and important problem. It is well written and well organized and the statement in the first foreword that it is not easy to read is perhaps the one to which the reviewer took chief exception.

STUART AXEL.

THE small handbook of 186 pages *Management in Obstetrics*<sup>2</sup> deals essentially with the handling of the complications of pregnancy and labor. As the writer states, "It tends to be dogmatic and alternative treatment is not described." In his preface the author states further "It is not claimed that the lines of treatment described are beyond question the best; they are merely those in which I believe myself." The above descriptions applied by the author fit the volume quite well. The book is recommended to the author's students. Whether it has a wider field of usefulness is a debatable question.

DOUGLAS P. MURPHY

*STERILITY AND IMPAIRED FERTILITY. PATHOGENESIS, INVESTIGATION AND TREATMENT.* By Cedric Lane-Roberts, Albert Sharman, Kenneth Walker, B. P. Wiesner and Mary Barton. 3d ed. New York and London: Paul B. Hoeber Inc., 1948.  
*MANAGEMENT IN OBSTETRICS.* By Andrew M. Clave, M.D., F.R.C.S., F.R.C.O.G. London, New York, and Toronto: Geoffrey Cumberlege, Oxford University Press, 1948.

THE book *Neurosurgical Pathology*<sup>3</sup> is the second of three volumes intended to cover the field of neuropathology and it is directed to the neurosurgeon. In this volume the neurosurgeon is to find a dynamic approach to neurosurgical pathology and a clinicopathological correlation of all common conditions coming into his sphere of activity. Had this been true it would have been a most acceptable achievement unfortunately it falls short of the mark. The question of whether there is such a thing as neurosurgical as opposed to neurological or medical neuropathology is open to considerable debate. Most of those working in the general field of neurology would regard this as carrying specialization too far. The only excuse for carrying specialization to this extreme would be a very complete, careful, and detailed exposition of all phases of this limited section of the subject, with reference to and discussion of the most recent work of other investigators also working in the field.

The book is divided into five chapters: cerebral swelling, 20 pages; central nervous system injuries, 110 pages; tumors of the central nervous system, intracranial tumors, 163 pages; cerebral abscess, 16 pages; hydrocephalus, 5 pages. The number of pages is given to show the relative emphasis. The bibliography contains about 350 references. The format of the volume is excellent and the illustrations are excellently reproduced. As a rule the illustration is on the same or the adjoining page to the written text, which is an obvious advantage.

The author has a very definite point of view concerning injury to the central nervous system. Cerebral swelling is rescued from the chaos of cerebral edema and described in detail. It contains the main thesis of the author's views of injuries which is that cerebral swelling can be divided into three stages: tumefaction, edema, and liquefaction, which are parts of the same biological process. The first stage consists of parenchymatous changes and vascular alterations characterized by vasoparalysis of veins and capillaries in the cerebral substance with congestion and stasis followed by swelling and degeneration of the endothelial cells. The other two stages follow naturally from this. In all stages cerebral swelling occurs principally in the white matter because of the discrepancy between its relatively poor blood supply and the much more vigorous interlacing supply of the cerebral cortex. This point is beautifully illustrated. The argument is supported by photomicrographs which unfortunately would not appear as conclusive

<sup>3</sup>NEUROSURGICAL PATHOLOGY. By L. Mark Scheinker. M.D. Springfield, Ill.: Charles C. Thomas, 1948.



to others as to the proponents of this view. The discussion of transtentorial herniation is well done and contains valuable information.

The chapter on injuries of the central nervous system again emphasizes the author's particular leanings and most of the references are to his own particular work in this field. Head injuries are classified according to his views in which reversible changes with vasoparalysis may go on to the irreversible changes of vasothrombosis with disseminated foci of tissue destruction. The profuse illustrations are excellent and clearly show the points under discussion. Sometimes a point appears to be carried too far the inference that midbrain hemorrhage may be secondary to transtentorial swelling is acceptable, but in trauma it may also occur directly. The illustrations do not always support the legends. Time cannot be told by one picture. However, in spite of a certain bias, this is a good chapter and of great interest to any neurosurgeon.

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There is a real question whether in consideration of a limited field the subject should not be more completely dealt with and more attention given to the recent work of others. There are some serious omissions in the bibliography. There is no reference to extradural tumors of the spinal cord, extradural abscess, peripheral nerve tumors or injuries or congenital defects of the central nervous system, all of which are of interest to the neurosurgeon. The first 120 pages of this book could be expanded, completed, and published as a separate monograph. It is interesting and stimulating and further work by scientists, in the direction suggested by Dr. Scheinker may confirm his point of view.

ADDISON VEE BROOKINGS.

THE authoritative reference work on *Viral and Rickettsial Infections of Man* should be welcomed by practicing internists in the medical field as a whole. The companion volume edited by René J. Dubos deals with bacterial and mycotic infections. The subjects covered in the present work are as follows:

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It is evident that the campaign against the bacterial diseases has made rapid progress in the last decade. The fight against virus diseases, however, is still in its early stages and somewhat analogous to the situation in the early years of this century when the treatment of bacterial diseases was primitive. The general knowledge, however, of the viruses and their diseases has expanded rapidly. It is to be hoped that revolutionary methods in diagnosis and therapy will soon be available. The present volume should contribute greatly to this much needed progress.

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THE second edition of *Abdominal Operations*<sup>1</sup> is an authoritative and practical book with contributions by outstanding surgeons of England, Australia and America.

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<sup>2</sup>THE PRACTITIONER TEXTBOOK. THE PRACTICE OF ENDOCRINOLOGY. Edited by Raymond Greene, M.A., D.M., M.R.C.P. London: Eyre & Spottiswoode, Ltd., 1918.

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Donald Hunter R. D. Lawrence J. M. Robson, F. F. Rundle, and P. H. Sandifer. Discussed in separate chapters followed by references, are the hypothalamus, pituitary gland, adrenals sex and reproduction, the thyroid gland, carbohydrate metabolism and diabetes mellitus, calcium metabolism and the parathyroid glands, the thymus and pineal body and adiposity. Although stress is laid on prac-

tice rather than on theory the related anatomy pathology and physiology are clearly and ably presented.

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WALTER H. NADLER.

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April, 1949

# SURGERY GYNECOLOGY AND OBSTETRICS

*Supplement*

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# INTERNATIONAL ABSTRACTS OF SURGERY

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## COLLECTIVE REVIEW

### VASCULAR MALFORMATIONS AND VASCULAR TUMORS OF THE GASTROINTESTINAL TRACT

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VASCULAR malformations and vascular tumors are rarely encountered in the gastrointestinal tract and no single investigator has had the opportunity to study more than a few cases. The relatively high incidence of serious clinical complications and malignant disease associated with these lesions was appreciated only after an extensive review of the literature and analysis of available histopathologic material. A comprehensive analysis of various methods of treatment and prognosis has been undertaken to assist further in securing satisfactory answers to the remaining unsolved problems.

#### MATERIALS AND METHODS OF STUDY

Vascular lesions involving the gastrointestinal tract have been reported since 1839 however their infrequent occurrence made it seem desirable to summarize every case report encountered in the available literature and thus to secure basic data for statistical analysis and for formulation of accurate conclusions. Table I gives a brief classification of all cases by type of lesion, by source, and by certain other characteristics. Table II summarizes the case reports appearing in the literature from 1839 to 1945, inclusive.

Abridgment of portion of thesis submitted by Dr. Gentry to the Faculty of the Graduate School of the University of Minnesota in partial fulfillment of the requirements for the degree of Master of Science in Surgery.

From the Department of Surgery Mayo Foundation, and the Section on Surgical Pathology and Division of Surgery Mayo Clinic.

The material utilized in this review included also the case records from the Mayo Clinic files through June, 1945 wherein a diagnosis had been made of either a vascular malformation or a vascular tumor of the gastrointestinal tract. Records of 106 vascular lesions were found in a review of approximately 1,400,000 case records. This group included 46 patients with vascular lesions observed at the time of surgical treatment, whereas, during a further study of more than 10,000 records of autopsies which were performed in the 30 year period from 1915 through 1944, 60 more vascular tumors or vascular malformations of the gastrointestinal tract were found. No esophageal varices were included in this study.

Both the surgical and autopsy specimens were examined and classified according to their histopathologic structure and their location in the gastrointestinal tract.

A clinical review and analysis of these 106 cases constitute the basis for the second part of this study, summarized in Table III.

#### PATHOLOGY

The description of the pathologic processes which are classified under the heading of vascular malformations and vascular tumors presents unusual difficulties. Vascular abnormalities may display either pronounced neoplastic properties of their own or subordinate themselves to complicated histopathologic changes which occur in various associated organs and tissues. The scope of



TABLE I.—VASCULAR MALFORMATIONS AND VASCULAR TUMORS OF THE GASTROINTESTINAL TRACT CASES BY TYPE OF LESION BY SOURCE, AND BY SELECTED FEATURES MENTIONED

Lesion	Cases by source						Condition mentioned, cases					
	Literature excluding clinic cases		Mayo Clinic		Total		Symptoms life	Treatment of lesion		Death from lesion	Lesion found incidentally & necropsy	Ratio of males to females
	Cases	Per cent	Cases	Per cent	Cases	Per cent		Op- ation	Other			
Benign, total	89	100	94	100	183	100	85	85	5	13	97	2.4:1
Telangiectasia	26	24	2	2	28		6	3		4		.6:1
Capillary hemangiomas	2	6	6	6	8	6	6	4				2.5:1
Mixed capillary and cavernous hemangioma	8	4			18	6	16	10		3		1:1
Multiple phlebectasia	4		34	35	38	21	7	6		3	37	2.8:1
Single polypoid cavernous hemangioma	26	0	14	5	40	12	40	3		4	36	6:1
Diffuse expansive cavernous hemangioma	23	0	3	5	26	4	22	8		1		9:1
Multiple diffuse cavernous hemangioma	24	7			24	6	5	4		3		2.4:1
Unclassified hemangioma	8		2		10	7	3	4	1	3	2	8:1
Malignant, total	45	100	6	100	51	100	6	0		20		1:1
Endothelioma	4	3			4	3	4	3	1			4:0
Hemangioendothelioma	8	8	4	66	12	22			5	4		9:1
Kaposi's sarcoma	14	3		7	21	3	5			5		4:0
"Benign" metastasizing hemangioma	4	9			4	7	4			4		9:1
Angiosarcoma	5		7	6	12	10	6	4		6		0:7

ing blood vessels, whereas 'angiomatosis' refers to the formation of outgrowths of ectopic endothelium-lined blood-containing spaces. The telangiectatic lesions are capillary in structure but, microscopically channels larger than normal are demonstrable.

As early as 1852 Rokitsansky (208) observed telangiectatic lesions in the mucous membrane of the intestine.

Interest in the hereditary type of hemorrhagic telangiectasia dates from a paper published in 1901 by Osler (184) although Rendn, in 1896 was the first to associate familial epistaxis and multiple telangiectasia of the mucous membrane in the gastrointestinal tract.

Still earlier in 1869, Wilson reported the first instance of gastrointestinal bleeding from telangiectatic lesions and called the condition 'eruptive angiomata.' Becker in 1926 and Magnusson, in 1934, collected the reports of cases from the literature and classified the various types of generalized and hereditary telangiectasia. Renshaw in 1939 reported the first case in which the lesion was seen with the gastroscope while Schuster Fox, and Goldstein listed the reports of fatal cases involving the gastrointestinal tract.

Pathogenesis and classification. Lanceplaine in 1904, advanced three theories for the patho-

genesis of generalized telangiectasia: (1) disturbance of the vasomotor nerves, (2) embarrassment of the general circulation, and (3) toxicity.

Hanes, in 1909 and later Gjessing in 1916 drew attention to the absence of elastic and muscular elements in the vessel walls in cases of hereditary telangiectasia.

The term 'telangiectasia' was soon recognized as a relative term, for few adults have not suffered a certain degree of peripheral vascular ectasia, and it has become evident that there are many pathologic lesions which can be grouped under this heading.

A consideration of those lesions which produce gastrointestinal hemorrhage centers primarily around the hereditary hemorrhagic group which form the basis for the collected reports of cases and for the histopathologic study presented in this review.

**Hereditary hemorrhagic telangiectasia.** Three classical requisites are necessary to establish a diagnosis of hereditary hemorrhagic telangiectasia: (1) history of repeated hemorrhages, (2) telangiectatic lesions of the mucous membrane of the nasal or oral cavities, viscera, or skin, and (3) a familial occurrence.

Fitz Hugh has shown that atavism unquestionably exists so that, although the disease is heredi-



this review will be limited primarily to a classification and clinicopathologic descriptions of those vascular lesions which involve the gastrointestinal tract. However a brief general discussion of histogenesis is presented with each group in order to assist with a more accurate and comprehensive classification of these lesions.

#### CLASSIFICATION

One of the most useful methods of classification of tumors is based on histogenesis; however a consideration of the histology and architecture of vascular lesions has been valuable in determining prognosis and methods of treatment.

Brown classified the hemangiomas of the intestinal tract according to their effect on the surrounding substrate and considered these lesions primarily from the standpoint of possible surgical intervention. Gross and Wolbach compared average sections in different tumors and grouped together those which matched most closely Kajfer's classification, which has been stated to be essentially that of Oberndorfer has many favorable attributes; however he included, in a benign group some vascular lesions which many pathologists consider to be malignant.

The following classification, based on histopathologic detail, tends to emphasize the value of certain forms of treatment and the resulting prognosis.

#### Benign vascular lesions

- A. Telangiectasis (hereditary and nonhereditary types)
- B. Hemangioma
  1. Capillary hemangioma (simplex, most by single)
  2. Mixed capillary and cavernous hemangioma
  3. Cavernous hemangioma
    - a. Multiple phlebectasis (small cavernous)
    - b. Simple polypoid (single cavernous)
    - c. Diffuse expansive (single contiguous)
    - d. Diffuse expansive (multiple non-contiguous)

#### Malignant vascular lesions

- A. Hemangioendothelioma
- B. "Benign metastasizing hemangioma"
- C. Kaposi's sarcoma
- D. Angiosarcoma

#### BENIGN VASCULAR TUMORS

Phillips (192) in 1839, described what was perhaps the first vascular tumor of the gastrointestinal tract reported in the literature. An indoor

servant in the service of a nobleman had three severe hemorrhages from straining at stool. A tumor the size of a French walnut was found in the rectum and irritation from neighboring parts made it tense and turgid. This vascular lesion had a livid, irregular fungous appearance and was attached to five-sixths of the anal margin. It was removed by needle ligature.

Syme in 1854, and Quain, in 1855, reported 3 more cases of soft vascular rectal tumors.

Rokitansky (107) in the English translation of his manual of pathologic anatomy published in 1855 mentioned the occurrence of vascular tumors in both the stomach and intestines. Regarding the stomach he wrote:

"Erectile tissue is either developed in the free ends of polyp, or the mucous membrane degenerates into it on a large surface, upon which the erectile tumor is attached by a broad base, or only by a very short neck or stalk. It is the common seat of encephaloid infiltration."

R. H. Ellis, in 1872, reviewed a case report published by Laboulbène in which a 64 year old man died of a single massive hemorrhage from an ulcerated cavernous hemangioma of the duodenum.

Virchow, Aebly, Thoma, Ribbert, and many others, before the turn of the nineteenth century contributed to the basic concepts of pathogenesis and histopathology of vascular malformations and tumors.

Brown, in 1924, classified the hemangiomas of the small and large intestine into four groups and collected reports of 19 cases from the literature.

Geschickter and Krasney reviewed the data on 570 tumors of the blood vessels listed in the surgical and autopsy records of the Johns Hopkins Hospital. The majority of these tumors were located in the subcutaneous parts of the body although the liver contained 109 of the lesions. Only 10, or less than 2 per cent, were divided between the spleen, intestines, and mesentery.

Kajfer in 1936 and after a careful study of the world literature, collected reports of only 74 cases of vascular tumors involving the gastrointestinal tract. He emphasized the roentgenographic appearance of phleboliths in these lesions and its possible value in diagnosis before surgical exploration.

In 1941 Morton and Burger described the first hemangioma seen during gastroscopy.

Christopher in 1942, found reports of 11 cases of vascular tumors involving the gastrointestinal tract which were cited in the literature since the comprehensive review by Kajfer.

**Telangiectasis** The term telangiectasis is generally considered to refer to dilatation of exist-

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	Cases	Per cent	Cases	Per cent	Cases	Per cent		Op- eration	Other				
Benign, total	89	100	94	100	33	100	86	86	5	33	97	2.4:1	
Telangiectasia	86	14	3		33		6	3		4		1.6:1	
Capillary hemangioma	3	6	6	6	8	6	6	14				5:1	
Mixed capillary and cavernous hemangioma	8	4		1	18	6	6			3			
Multiple phlebectasia	4		54	58	94	33	7	6		3	77	5.8:1	
Single polypoid cavernous hemangioma	16	9	14	3	50	18	40	23	1	4	10	6:1	
Diffuse expansive cavernous hemangioma	15	9	3	3	40	4	38	8				0.0:1	
Multiple diffuse cavernous hemangioma	14	7			16	6	3	4		3		1.4:1	
Unclassified hemangioma	18				19	7	3	4		3		8:1	
Malignant, total	43	100	6	100	6	100	6	9		19		1:13	
Endothelioma	14	3			14	3	4	3		0		4:0	
Hemangioendothelioma	8	8	14	84	33				3	4	0	9:1	
Kaposi's sarcoma	4	11		7	13	3	3			3		4:0	
Benign metastasizing hemangioma	4	9			4	7	4			4		0:3	
Angiosarcoma	3			7	6		6	4		6	0	7:1	

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pulmonary tissue in the skin of reptiles and lower forms.

In an extensive study of patients with cutaneous hemangiomas Watson and McCarthy found that more than 73 per cent of the vascular lesions were present at birth. This strongly supports the theory for congenital origin of all vascular tumors.

According to Cockayne, there seem to be no long pedigrees showing a direct or indirect inheritance of any of the common forms of vascular tumors. The number of twins in which obvious angiomas have been present is too small to permit definite conclusions.

Comparatively little attention has been paid to the histologic changes which take place during the growth and development of hemangiomas.

The evolution of lesions appearing on the surface of the body has been exhaustively studied by Groes and Wolbach. They postulated the following factors which may influence or arrest the development of hemangiomas: first, a deficient blood supply may convert the surrounding tissue into a dense fibrous layer and thereby may produce perivascular and endovascular thickening of the endothelial lining with resultant progressive obliteration; second endothelial cells may proliferate and become vacuolated into embryonic capillary hemangiomas and third embryonic capillary hemangiomas may establish a connection with the circulation which under pressure, causes the endothelium to become thinner and cavernous blood spaces to enlarge to form cavernous hemangiomas.

**Capillary hemangioma.** The capillary form of hemangioma consists of a new growth of small closely packed blood vessels with well differentiated endothelium. Hyperplasia of these endothelial lining cells is a constant feature and may tend to obliterate the vascular spaces. The connective tissue stroma is deficient in elastin and muscular tissue. The general structure of the tumor is more embryonic than that of the cavernous hemangioma.

Capillary hemangiomas often appear as single, discrete encapsulated tumors in the gastrointestinal tract. They arise from outpocketings of the submucosal vascular plexus and enlarge toward the lumen of the associated hollow viscus. Their outside diameter may vary from that of 1 by 1 cm. plaques to that of pedunculated tumors measuring 11 by 3 by 2 cm. which tend to cause intussusception and obstruction.

The capillary hemangiomas which develop in the esophagus and small intestine are generally smaller and produce symptoms earlier than those found in the stomach and colon. Ulceration of

the mucosal surface was present in more than one half of the cases cited in the literature and in this study.

Differential diagnosis. Broders observed in 1923 that it is sometimes difficult to distinguish melanocapithelioma from capillary hemangioma, especially if the endothelial cells have picked up blood pigment. Microscopic sections of a melanocapithelioma, when stained, will be iron free, whereas those of a hemangioma contain iron.

Capillary hemangiomas are sometimes mistaken for hemangioendotheliomas. A study of their histopathology as it relates to invasion, metaplasia, atypical mitosis, and local or distant metastasis will assist in the differentiation.

Distribution symptoms and treatment. Data on 283 benign vascular tumors were collected from the literature and from the records used in this study. Eighteen, or 6 per cent, of these lesions were classified as capillary hemangiomas. These tumors were found to occur in every anatomic segment of the gastrointestinal tract.

The symptoms, complications, and treatment of capillary hemangiomas depend primarily on the specific location of the lesions in the gastrointestinal tract and will be considered in another section of this review; however certain general observations are of interest when each separate group of pathologic lesions is considered. Sixteen or 89 per cent, of the patients with capillary hemangioma experienced symptoms from chronic blood loss, perforation, or intestinal obstruction. Surgical extirpation was possible in 14, or 78 per cent, of the cases, whereas 2 patients died, one of esophageal perforation and the other a 12 day old infant, of hemorrhage from a gastric hemangioma.

**Mixed capillary and cavernous hemangiomas.** The classification of hemangiomas depends primarily on grouping different lesions which have the same average cellular arrangement. A cut section through a mixed capillary and cavernous hemangioma presents solid areas of hyperplastic endothelial cells and semi-obliterated vascular spaces which alternate with large blood filled sinuses lined by a single layer of endothelial cells and supported by connective tissue septa containing moderate amounts of elastin and sometimes muscular tissue.

The mixed capillary and cavernous hemangiomas like the capillary hemangiomas, arise from the submucosal vascular plexus, are often encapsulated in a thin layer of fibrous tissue, tend to enlarge toward the lumen of the contiguous viscus, may become pedunculated, and frequently ulcerate through the overlying intestinal mucosa.

Eighteen mixed capillary and cavernous hemangiomas were found during this review. The majority were located in the stomach, small intestine, and appendix. It is interesting to note that in 8 of the patients clinical signs and symptoms of subacute intestinal obstruction developed. Surgical extirpation of the vascular lesion was successful in each of these cases. Two other patients in whom exploration was performed following a tentative diagnosis of acute appendicitis each had a primary vascular tumor of the appendix which had undergone torsion and infarction. Three patients died as a result of complications associated with mixed capillary and cavernous hemangiomas.

**Cavernous hemangiomas.** The cavernous forms of hemangioma consist of large blood-filled spaces or sinuses lined by single or multiple layers of endothelial cells. Their supporting stroma is composed of scant connective tissue septa which may contain smooth muscle fibers. These tumors, like the capillary hemangiomas, must be distinguished from lesions which develop after regenerative, inflammatory or circulatory disturbances.

Growth occurs at the periphery of cavernous hemangiomas by angioblastic proliferation, dilatation of the capillary spaces, and fusion of the intervascular connective tissue walls to form septa. Degenerative and sclerosing changes may appear early in the evolution of these tumors and are represented by coagulation of blood in the cavernous spaces, overgrowth of fibrous tissue hyalinization, edema, and foci of calcification.

Four histopathologic subdivisions of the cavernous tumors were made in this review.

1. Cavernous hemangiomas of the multiple phlebectasia type. Cavernous hemangiomas of this group are characterized by a multiplicity of small discrete lesions found in any or all segments of the gastrointestinal tract. As many as 50 separate tumors have been counted in a 20 cm. length of the small intestine. The majority of lesions are confined to the submucosa and rarely exceed 1 cm. in diameter.

A close association with the normal vascular segments of the bowel is easily demonstrated by compression of the tumors at the time of surgical treatment. They are seen to blanch and, with release of pressure, immediately to refill with blood. Moeller considered them to be baglike distentions attached to venous vessels at only one point; however, on careful examination of fixed specimens, more than one communication with the submucosal capillary network may be identified, and the lesions have the same multiplicity of associated sinuses and connective tissue septa and

the same deficiency of elastin and muscular tissue as do other cavernous hemangiomas.

Increased venous pressure in the portal circulation might be considered an etiologic factor; however, no lesions have been observed in association with either Banti's syndrome or advanced cirrhosis of the liver. The lesions are consistently larger than the lesions obtained at biopsy from patients having multiple hereditary telangiectatic lesions and there is no known familial tendency.

The incidence of these lesions has been difficult to estimate since they are often disregarded in the postoperative notes and frequently are overlooked during postmortem examinations. Moeller found only 3 cases during 18,000 to 19,000 autopsies, whereas in our study of more than 10,000 autopsy reports, 49 cases were encountered. Reports of 94 cases were collected for this review; these cases represent approximately one third of all the benign vascular lesions found in the gastrointestinal tract.

The frequent occurrence of these lesions, contrasted with the rare occurrence of symptoms, might lead one to consider them as mere pathologic curiosities; however, 14 cases in which hemorrhage into the bowel or retroperitoneal space occurred have been cited in the literature. Three of the patients died.

The phlebectasia type of hemangioma generally involves long segments of the gastrointestinal tract. Consequently surgical extirpation is impossible unless a definite bleeding point which can be locally excised is demonstrated. One patient from the Mayo Clinic series with hematemesis and melena during the previous year underwent exploration and was found to have numerous lesions in the small intestine. In this case snake venom was given in decreasing amounts for the succeeding 4 years with no further gastrointestinal bleeding. Study and further evaluation of this method of treatment is necessary.

2. Cavernous hemangiomas of the simple polypoid type. The simple polypoid hemangiomas appear as single isolated cavernous lesions associated with the submucosal vascular plexus. They may enlarge and prolapse into the lumen of the associated hollow viscus and thereby cause ulceration, hemorrhage, and intestinal obstruction.

The general incidence of these lesions is much lower than that of the preceding group; however, a larger proportion of cases has been reported because of the tendency of the lesions to produce gastrointestinal symptoms which require treatment. There were records of 14 cases at the Mayo Clinic and reports of 36 cases were found in the literature; thus, these 50 cases represent 10 per

cent of all the benign vascular tumors located in the gastrointestinal tract.

Eighty per cent of the polypoid cavernous hemangiomas encountered in this review produced gastrointestinal hemorrhage or obstruction.

Surgical extirpation was possible in more than 46 per cent of the cases. Four patients (8%) died.

3 Cavernous hemangiomas of the diffuse expansive type. Cavernous hemangiomas in this subgroup are characterized by great variation in size, shape, and effect on the immediate substrate. Many of these tumors are found to involve from 20 to 30 cm. of the gastrointestinal tract in one contiguous segment. Their gross appearance in the peritoneal cavity is determined by the structures covered by the expansive lesion, whereas in the rectum they produce soft, compressible, nodular dark purple elevations under the mucosa.

Microscopic examination of sections through the periphery of these tumors reveals numerous dilated tortuous vessels as well as an abundance of smooth muscle and fibrous connective tissue stroma. One might therefore postulate the convergence of normal vascular structures in the antecedent history of these lesions. In other areas, however, the typical histopathologic pattern of cavernous hemangiomas is demonstrated with no evidence of smooth muscle or elastic fibers in the connective tissue septa.

Records of 40 diffuse cavernous lesions were found and 38, or 95 per cent, produced symptoms. Gastrointestinal bleeding was observed in 23 cases, while obstruction to the lumen of the bowel occurred in 14 others. The serious nature of these complications is emphasized by the fact that death occurred in 27 per cent of the cases.

Eighteen patients had diffuse cavernous hemangiomas in the small intestine. Five experienced severe gastrointestinal hemorrhage, while 5 others had symptoms from obstruction. Only 4 patients had both intestinal bleeding and obstruction. Resection of the tumor was possible in 8 cases, with 3 deaths. An exclusion type of operation was performed in 1 case, but the patient died of a severe hemorrhage from the remaining hemangioma.

The records of 20 patients with diffuse cavernous hemangiomas of the colon and rectum are summarized in Tables II and III. Seventy-five per cent of these lesions produced hemorrhage, while 25 per cent caused some degree of obstruction to the lumen of the bowel. Nine hemangiomas were excised whereas colostomy with injection treatment or roentgen therapy was utilized in 2 other cases. An over-all mortality rate of 45 per cent from these tumors was observed.

In the majority of patients with a large cavernous hemangioma of the rectum the onset of hemorrhage is noted soon after birth. Severe bleeding recurs until some adequate form of treatment is instituted or the patient may die of profound shock early in life. The natural tendency toward conservative forms of treatment for these so-called benign lesions must be carefully weighed against the very high morbidity and mortality rates associated with symptomatic treatment. In general, the prognosis is grave unless resection of the rectum with excision of the associated tumor is undertaken or some type of colostomy is combined with extensive roentgen therapy.

4. Cavernous hemangiomas of the multiple diffuse expansive type. Diffuse cavernous hemangiomas may occur simultaneously in separate organs or tissues throughout the body. Sixteen cases in which multiple lesions occurred were found in this review. Two of the patients had hemangiomas of the stomach and similar lesions on the surface of the body. In each of the 14 others 1 diffuse expansive hemangioma was located in either the colon or rectum while a second and rarely a third cavernous hemangioma involved adjacent viscera within the peritoneal cavity or was located on the surface of the body.

Fifteen, or 94 per cent, of the patients had severe rectal hemorrhages. Gross hematuria was present in 2 cases in which cavernous invasion of the urinary bladder occurred.

The treatment given these patients was individualized to fit the location of the tumor and the severity of the complications. Three died of severe exsanguinating hemorrhages while another died of peritonitis following resection of the colon with excision of the associated tumor. One patient was free of symptoms after a combined abdominoperineal resection for a cavernous hemangioma. Five patients continued with hemorrhage in spite of conservative treatment.

#### MALIGNANT VASCULAR TUMORS

In spite of the fact that benign vascular tumors are exceedingly common, their transitional forms and malignant counterparts are rarely seen. In an extensive review of the literature, Stout felt compelled to reject many of the lesions labeled with some name suggestive of a malignant vascular tumor. This was done because of inadequate histologic reports or because he considered that the illustrations and text described a tumor of some other kind. On the other hand Broders and many others (174, 233) have presented very detailed and carefully defined criteria for the classification of various malignant vascular neoplasms.

TABLE II.—PUBLISHED CASE REPORTS OF VASCULAR LESIONS OF THE GASTROINTESTINAL TRACT ACCORDING TO TYPE

Teleangiectasis, Hereditary and Nonhereditary

Author year	Sex, age	Location	Remarks
Oaker (84) 901	M 55	Lips, nose, stomach	Lesion 3 by 4 mm. Family history positive. Epistaxis, coffee-ground vomitus. Dead
Libert 918	M 45	Stomach	Collapsed small vessel in mucosa. Family history positive. Melena. Gastro- intestiney. No gross ulceration. No further bleeding
Boston 920	F 70	Stomach, neck, chest	Family history questionable. Hematemesis and melena since childhood. Death from gastric hemorrhage
Boston 1930	M 32	Stomach, lips, face	Hematemesis and melena since childhood. Ligation of arterial supply to vascular area. No further bleeding for 5 years
Kessel 1931	M 52	Stomach, nose, lips	Possible teleangiectasis. Melena. Partial gastrectomy. Continued bleeding. Family history positive
Schuster 937	F 62	Stomach, nose, pharynx	Recurrent gastric hemorrhages throughout life. Lesions found at autopsy. Family history positive
Roskrow 939	M 44	Stomach, lips, tongue	Recurrent pharyngeal and gastrointestinal bleeding for years. Seen at gastrectomy
Watson and McCarthy 940		Stomach, lips	Repeated hematemesis. Family history positive
Watson and McCarthy 1940		Stomach, pharynx	Death from gastric hemorrhage
Reifler 942 (1940)	F (7) 50 (50)	Stomach, nose, tongue	Repeated gastrointestinal bleeding. Lesions found at autopsy. Family history, positive
Wilson 1940		Gastrointestinal	Gastrointestinal bleeding
Fox 948	F 5	Nose, trunk, gastrointestinal	Epistaxis and gastrointestinal bleeding, 5 years
Hitchcock and Olney 949	M 49	Mouth, rectum	Hematemesis and melena. Family history positive
Richards 947		Nose, gastrointestinal	Gastrointestinal hemorrhages before onset of epistaxis
Barford 946		Nose, gastrointestinal	Severe recurrent hematemesis, epistaxis, melena. Family history positive
Barks 946	M 60	Eris, mouth, tongue, gastro- intestinal	Intermittent appearance of lesions. Recurrent epistaxis and melena. No family history
Harper 949		Gums, tongue, gastrointestinal	Recurrent bleeding from tongue, tarry stools. Family history positive
Boston 949	M 40	Nose, gastrointestinal	Recurrent epistaxis and hematemesis. Family history positive
Fitz-Hugh 1	M 61	Nose, colon, rectum	Recurrent epistaxis and melena since childhood. Partial biopsy positive
Fitz-Hugh 81	F	Nose, tongue, gastrointestinal	Recurrent epistaxis and melena
Gekhter (1) 1917 (1908)		Stomach	positive
Olgers and Baker 194	M 40	Nose, skin, gastrointestinal	since for 20 years. Skin biopsy
Olgers and Baker 194	F 30	Skin, nose, mouth, gastro- intestinal	since childhood. Multiple transudates
Olgers and Baker 194	F 30	Nose, pharynx, gastrointestinal	Family history positive
Fitz 194		Maxillopharynx	positive

TABLE II.—PUBLISHED CASE REPORTS OF VASCULAR LESIONS OF THE GASTROINTESTINAL TRACT ACCORDING TO TYPE—Continued

Capillary hemangiomas, simplex or single			
Author year	Sex, age	Location	Remarks
Vinson, Moore and Bowling 1916	M 70	Esophagus	1
Lammers 1893	M	Stomach	Incidental finding at autopsy. No symptoms
Stocks 1904-05	1 days	Cardia of stomach	Severe hematemesis and melena. Death
Eusterman and Seaty 1911	F 50	Stomach	
Eusterman and Seaty 1912	M 50	Stomach	
Eusterman and Seaty 1913	M 67	Stomach	Reported by Lemon and by Judd and Rankin
Judd and Rankin 1911	M 67	Stomach	Reported by Lemon and by Eusterman and Seaty
Judd and Rankin 1912	F 51	Stomach	Reported by Eusterman and Seaty <sup>1</sup>
Judd and Rankin 1912	M 52	Stomach	Reported by Eusterman and Seaty
Sieboer 1913		Cardia of stomach	Resection of stomach
Eusterman and Ballou 1915	F	Stomach	Reported by Eusterman and Seaty and by Judd and Rankin
Eusterman and Ballou 1915	M 50	Stomach	Reported by Eusterman and Seaty
Gladden 1917	M 40	Stomach	Lesion by 1 cm. Found incidental to operation for stab wound
Carman 1917	F	Stomach (pylorus into duodenum)	Reported by Eusterman and Seaty and by Judd and Rankin
Ballou and Henderson 1919	F	Stomach	Reported by Eusterman and Seaty by Judd and Rankin and by Carman
Rankin and Newell 1921	F 52	Stomach	Reported by Eusterman and Seaty by Judd and Rankin, by Carman and by Ballou and Henderson
Oberdorfer 1929	M 43	Upper part of small intestine	
Lichtenstam and Dietz 1943	F 68	Ileum	"Angiofibroma." Intestinal obstruction. Double intussusception, resection. No further symptoms
Weber 1956	M 43	Cecum	Beginning invagination of ileocecal area. Resection
Fobes 1958	F 53	Cecum	Fibrocapsillary lipoma, 4.5 by 4.5 cm. Pain, cramps and vomiting. Intussusception of cecum. Resection. Recovery
Sawyer 1959	M 55	Sigmoid colon	Lesion 5 by 5 cm. Intestinal obstruction. M. laxa. Milne's resection. Recovery
Edwards 1968	F 48	Extraintestinal	Angiofibroma. Enlargement for years. Resection. Recovery
Forrester 1976	F 40	Rectum, rectovaginal septum	Hemangioma. Tumor protruding at vulva, years. Rectovaginal fistula. Resection. Recovery
Mixed capillary and cavernous hemangioma			
Morton and Burger 1911	F 35	Stomach	Cavernous hemangioma. Endothelial proliferation



TABLE II.—PUBLISHED CASE REPORTS OF VASCULAR LESIONS OF THE  
GASTROINTESTINAL TRACT ACCORDING TO TYPE.—Continued  
Mixed capillary and cavernous hemangioma—continued

Author year	Sex, age	Location	Remarks
Laboulbène 87	M 64	Duodenum	Erectile tumor. Capillary spaces and acellular dilatations. Recurrent hemorrhage and anemia. Death from massive hemorrhage.
Mayer and Schramm 934	M 58	Duodenum	Diffuse slender hemangioma. Persistent chronic gastrointestinal hemorrhage. No operation. Death.
Song 912-1914	M 3800	J jejunum	Hemangioma, thick-walled vessels and partly large spaces. Investigation. Resection. Recovery.
Radford 1914	M 60	Jejunum	Hypertrophy of blood vessels and cellular infiltration. Anemia, weight loss, increasing constipation, pain, vomiting, hematemesis, 6 months. (Circulus of blood of jejunum).
Marchant 939	F 6	Jejunum	Small capillary and large vascular spaces (3 by 3 cm.). Intestinal obstruction. Death while in shock from bleeding and intussusception of polypoid tumor.
Mascher 938	M 31	Appendix ( 1 cm. in length)	Angiofibroma, all portions of the vascular system reproduced. Symptoms of acute appendicitis, tension of tumor of appendix.
Quain 1855	M 3	Rectum	Pedunculated, spongy vascular tumor. Half teaspoon of blood lost with each bowel movement. Resection. Recovery.
Cavernous hemangioma, multiple phlebotoma type (small cavernous)			
Sommer 1860	F 76	Esophagus and rectum	Multiple small cavernous lesions in submucosa. No digestive symptoms. Death from infection of hand.
Reincke 908	M 31	Entire gastrointestinal tract	Schwannoma, communicating blood-filled cavities. Death from tuberculous meningitis. No known digestive symptoms.
Ducloux, Kambien and France 944	F 19	Esophagus	Many endothelium-lined polypoid spots. Hematemesis at 5 and menses at 10 years of age. Spontaneous rupture of bleeding. Esophagoscopy, biopsy and intubation of tumor. Well 1 year after treatment.
Lille 879	M 60	Stomach and upper part of jejunum	Multiple hemangiomas. Death from renal gangrene and bronchopneumonia.
McClure and Ellis 930	F 30	Stomach, jejunum, liver, and spleen	Multiple hemangiomas ( 1 mm. to 35 mm.). Recurrent severe gastrointestinal bleeding, 10 years. Laparotomy. Rupture of bleeding. Esophagoscopy, biopsy and intubation of tumor. Death from hemorrhage.
Marchant 939	M 8	Stomach, jejunum, left kidney and adrenal	Multiple hemangiomas ( 3 by 3 cm.). Anemia, 8 years. Intussusception of jejunum. Operation. Death.
Okubo 1907	M 79	Small intestine	Multiple hemangiomas. No known gastrointestinal symptoms. Death from pneumonia.
Achmann 937	M 4	Duodenum, jejunum, colon, gall bladder	Multiple cavernous hemangiomas. Anemia. Occult blood. Death from retroperitoneal rupture of duodenal hemangioma. No intestinal ulceration.
Georgyev 1866	M 40	Body surface, small intestine	Multiple cavernous hemangiomas. Death from suppuration with enlarging angiomatous glands.
Thierfelder 87	M 48	Small intestine	Cavernous hemangioma. No clinical symptoms. Death from trauma.
Thierfelder 1873	M 43	Small intestine	Multiple hemangiomas. No clinical symptoms. Death from varicella.
de Boyer 1877	M 6	Small intestine	Multiple hemangiomas. No clinical symptoms. Death from pneumonia. 1st hemangioma.
Lille 879	M 55	Jejunum, colon, rectum	Multiple submucosal hemangiomas. No clinical symptoms. Death from cancer of colon.
Lille 879	M 65	Small intestine	Multiple hemangiomas. No gastrointestinal symptoms. Death from pulmonary tuberculosis.
Ort 1880	M 61	Small intestine, colon	Multiple hemangiomas. No intestinal symptoms. Death from infection.
Herkston 1897-1899	M 48	Small intestine	Dilated veins, cavernous hemangioma. No intestinal symptoms. Death from renal calcification.
MacCallum ( 10) 1908	M 54	Small intestine	Multiple hemangiomas. Alcoholic, vomited blood one time. Digestive disturbance for 6 months. Death from pneumonia.
Mascher 19	M 5	J jejunum	Multiple hemangiomas. Death from carcinoma of esophagus.
Mascher 1907	M 48	Small intestine	Multiple hemangiomas. Death from trauma. No intestinal symptoms.

TABLE II.—PUBLISHED CASE REPORTS OF VASCULAR LESIONS OF THE GASTROINTESTINAL TRACT ACCORDING TO TYPE—Continued

Cavernous hemangiomas, multiple phlebectasia type (small cavernous)—continued

Author year	Sex, age	Location	Remarks
Möller 97	M 47	Small intestine	Multiple hemangiomas. Infectious diarrhea
Schmalzke 924	M 43	Small intestine	Multiple hemangiomas
Staemmler 924	M 67	Small intestine	Multiple hemangiomas. Death from carcinoma and syoma of ileum
Staemmler 924	M 65	Jejunum	Multiple hemangiomas. No gastrointestinal symptoms
Saint 927		Small intestine	Multiple hemangiomas
Toepfer 926	no	Intestine	Multiple simple angiomas with capillary "ectasia." Also skin, mouth, submaxillary gland, thyroid, liver, lungs, urinary bladder involved.
Jaffé 929	F 20	Small intestine, sigmoid	Multiple blood-filled spaces. Death from acute suppurative conditions and pyelitis. Also skin, thyroid, lungs involved
Ralford 93	M 54	J. jejunum	Numerous hemangiomas. Death from bronchopneumonia
Dudley 934	M 56	Small intestine studded	Multiple hemangiomas (5 by cm.). No symptoms one year after operation
Bull and others 934	M 45	Small intestine, colon, rectum	Multiple hemangiomas. Gastrointestinal bleeding. Preoperative diagnosis of "ulcer." Seen with proctoscope
Berns, Hüllermand and Gensel 935	F 55	Jejunum, sigmoid	Multiple hemangiomas. Many episodes of melena. N. resectable lesion found on exploration
Ackerman 937	M 64	Ileum, jejunum	Six cavernous hemangiomas. Seen at autopsy
Merschaut 939	M 64	J. jejunum	Multiple hemangiomas. No known gastrointestinal symptoms. Death from hypertensive heart disease
Spovsky 94		Ileum	Multiple cavernous hemangiomas
Lille 879	M 50	Colon	Multiple hemangiomas. Death from infection in various organs
Neelsen 879	M 56	Colon	Multiple hemangiomas. Psychosis. Death
Möller 97	M 44	Sigmoid, mesocolon	Multiple hemangiomas. Death from carcinoma of esophagus
Staemmler 924	M 78	Colon	Multiple hemangiomas
Tjomsen 93	M	Ascending colon	Multiple hemangiomas. Carcinoma, tuberculous, and ileocecal invagination
Letter 935		Gastrointestinal tract	Multiple cavernous hemangiomas
Anderson 938		Gastrointestinal tract	Multiple cavernous hemangiomas
Carnot 979	37	Esophagus	Cavernous hemangioma on pedicle. Two severe episodes of hematemesis in 6 months. Death from shock from hemorrhage of tumor
Cockle 93		Esophagus	
Rokitansky (190) 855		Stomach	"Erectile" tumors. May have been attached by broad base
Judd and Rankin 9	F 5	Stomach	Reported by Ewterman and Senty
Ewterman and Senty 9	F 5	Stomach	Reported by Judd and Rankin
Ewterman and Haller 935		Stomach	Reported by Judd and Rankin



TABLE II.—PUBLISHED CASE REPORTS OF VASCULAR LESIONS OF THE GASTROINTESTINAL TRACT ACCORDING TO TYPE—Continued

Cavernous hemangioma, multiple phlebotactasia type (small cavernous)

Author year	Sex, age	Location	Remarks
Gabriel 037	M 9	Rectum	Rectal hemangioma. Recurrent rectal hemorrhage since 3 years of age. Resection. N hemorrhage after months
Phillips (9) 830	M 8	Anus	Erectile tumor. Rectal hemorrhages. Irritation made it tense and turgid. Ligature slough. Recovery
Gorham 840		Anus	Erectile tumor*
Syme 854	M 8	Anus	Vascular tumor by 4 loches. Soft red tumor present since birth. Recurrent severe hemorrhages. Ligature. Removal. Recovery
Rokhtansky (200) 855		Colon, rectum	Mentioned a blood-vascular new growth in his pathology text
Paul 883	F 60	Gastrointestinal tract	Intestinal obstruction. Tumor torn loose from bowel during violent purging. Hemorrhage. Recovery

Cavernous hemangioma, diffuse expansive type (single contiguous)

Kegaries 933		Esophagus	Secular dilatations, hemangioma
Wakeley 938	F 6	Liver; extrinsic pressure on esophagus	Increasing dysphagia, 5 years. Vomiting. Hemangioma the size of closed fist removed from liver with diathermy. Recovery
Morton and Burger 947	M 36	Cardia of stomach	Lesion 6.5 by 4 cm. Epigastric pain, year. Gastroscopy: polypoid mass on lesser curvature. Operation: numerous large tortuous blood spaces. Resection not attempted
Beer 953	F 9	Duodenojejunal junction	Lesion 30 by 16 inch. Increasing weakness, hematemesis, melena, 5 years. Duodenojejunostomy with excision of bowel and cavernous hemangioma. Postoperative hemorrhage, death
Delbet 959	F	Small intestine	Lesion 1 by 3 cm. Chronic, subacute intestinal obstruction, long duration. Resection. Death
Ruedekes 953	F 36	J junction	Lesion 8 cm. long. Recurrent attacks of abdominal pain. Resection. Recovery
Brown 954	F	J junction	Lesion 5 by 3 inches. Recurrent abdominal pain, vomiting and distention, a few months. Resection. Death
Landsle 955	F 5	Ileum	Lesion 8 cm. long. Symptoms simulating acute appendicitis. Resection. Recovery
Michalson 957	F 120.	Ileum	Severe vomiting, bloody stools, and palpable mass. Resection. Death from peritonitis
Bessert 960	M 33	Jejunum	Mucosal ulceration. Whole small intestine filled with blood at autopsy. Death from pulmonary tuberculosis
Kortshorn 960	M 4	Small intestine	Lesion 5 cm. long. Intestinal bleeding. Resection. Recovery
Peyton 958	M 18	Jejunum, ileum	Pale, weak, severe anemia since birth. Exploration. Postoperative high voltage roentgen ray. No hemorrhage for 8 months
Pierore 969	F 40	Jejunum	Diffuse hemangioma. Bright red blood passed 3 days after birth. Weakness, tarry stools, anemia, 15 years. Three abdominal explorations. Resection. N further symptoms
Morrison and Donald 941		J junction	Lesion 60 cm. Two explorations, negative. Diagnosis after extensive roentgenologic examination
White 945	M 13	Ileum	Lesion 5 inches long. Abdominal distress and severe intestinal hemorrhage. Resection. Recovery
Stajano 945	F 16	Jejunum, mesentery	Did not involve gastrointestinal tract
Packard 945	F 16	Ileum	Lesion 8 by 4 by 2.5 cm. Frequent episodes of nausea, vomiting, cramps, marked weakness, and dark stools. Resection. Recovery
Bale and Swan 959	F 47	Appendix, cecum	Reported by Hunt
Kaschmann 969	M 31	Cecum	Hyperplastic angioma (8 by 8 cm.) Intestinal obstruction. Intussusception. Resection. Recovery
Hunt 945	F 47	Appendix, caecum	Reported by Bale and Swan

\*Clinical details given in Table 3.



TABLE II.—PUBLISHED CASE REPORTS OF VASCULAR LESIONS OF THE GASTROINTESTINAL TRACT ACCORDING TO TYPE—Continued

Cavernous hemangioma, diffuse expansive type (single contiguous)

Author year	Sex, age	Location	Remarks
Stacy 08	F 31	Uterus, colon, rectum	Severe rectal hemorrhages. Sigmoidoscopy Laparotomy Death during shock
Dujarier and Topous Khan 190	M	Sigmoid, colon	Intermittent rectal hemorrhages, anemia, weight loss
Ralby 1938		Colon para-aortic area	Recurrent attacks of bleeding and diarrhea throughout life. Death from taphylococcus septicaemia
Watson and McCarthy 1940	15	Kidney colon	Same case as Dean and McCarthy given below
Dean and McCarthy 1940	35	Right leg, sigmoid, colon	Cited by Watson and McCarthy
Gent 1913 (cases)		Rectum	Hemorrhage from slightest trauma since infancy
Withers and Ramson 1917	F 100	Buttocks, vagina, rectum	Defecation impossible since birth without enema. Rectal hemorrhages. Radium tubes and radon seeds applied and growth regressed
Esa 191	M	Scrotum, rectum, penis	Bleeding since infancy. Operation. Recovery
Bernardo and co-workers (16) 191	M 44	Perineum, scrotum, penis, rectum	Rectal hemorrhage all life. Vasconstrictor drugs and radium therapy. Operation refused
Bernardo and co-workers (16) 191	M 41	Perineum, scrotum, penis, rectum	Bleeding from rectum since 6 years of age. Symptomatic treatment
Bela and Newsholm 1918	M 18	Rectum, kidney	Death from hemorrhage from rectum
Bernardo and Bertillon 1918	M 30	Anus, rectum, scrotum	Alternating constipation and diarrhea. Some bleeding from rectum

## Hemangioma, details insufficient for classification

Bouchard 1913	F	Esophagus	"Nervous. Alcoholic, cirrhosis, cutaneous nevi, death from hematemesis. Perhaps esophageal varices
Gelsen 1913	M	Esophagus or stomach	Vascular tumor increasing dysphagia, is smooth. Esophagoscopy Esophageal bougies and local application of radium gave an ultimate satisfactory result
Anschuetz and Koefetzky 1919		Stomach	Alleged hemangioma.
Ellison et al 1916		Stomach	Listed on chart only
Gutmann et al 1915	M 45	Stomach	Possible hemangioma. Severe hematemesis and melena. Gastroenterostomy. Bleeding continued. Nephrectomy and thorax
Geschickter 1915		Stomach, small intestine, rectum	Listed on chart from Johns Hopkins Hospital
Milnes and Geschickter 1916	M 18	Stomach	Pain, vomiting, weight loss, death from gastric cancer
Marshall 1911	55	Stomach	Angioma. Associated with hereditary phillips capillitis
Wassner 1883	M 55	Duodenum	Tubercle-like, 1 by 2.5 cm. Vascular tumor contiguous with another tumor which rested upon the pancreas compressing the common bile duct
Hartman (104) 1915		Urem	
Peterson 1918 (cases)	M? 10, 17	Cecum	Angioma, infarction of cecum. Electrotomous colostomy. Resection of cecum. Recovery

Clinical details given in Table 1.

TABLE II.—PUBLISHED CASE REPORTS OF VASCULAR LESIONS OF THE GASTROINTESTINAL TRACT ACCORDING TO TYPE—Continued

Hemangioma, details insufficient for classification

Author year	Sex, age	Location	Remarks
Carbondell Belser 1936 ( case)		Small intestine	Angioma
Klein 1935		Appendix	Solitary hemangioma
Anderson 1943	M 3	Oesophagogastric	Teleangiectasia. Intermittent rectal bleeding, source not known
Reichel and Scaumbler 1944	M 18	Colon or rectum	Seen at autopsy
Valerie 1933		Rectum	Angioma and angiomatosis
Duch and Jones 1943		Small intestine	Listed in chart of benign tumors
Carrara 1916		Esophagus	Tumor found at autopsy
Broders 1933	F 75	Esophagus	
Chocroff 0		Stomach	
Sherrill and Oraven 1915	F	Stomach	Extensive tumor. Mass and tenderness. Nausea, hematemesis, pain, anorexia. Re- section of tumor
Dahlgren 1934	M 41	Stomach	Hemangioma. Large firm nonulcerated epigastric mass. Tumor excised with piece of gastric wall
Levine and Broders 1943	F 36	Stomach	Not reported in detail
Field et al 1915	F 80	Stomach	Lesion 3 by 1 cm. Vomiting, obstruction, and distention, days. Necessary because of condition. Death
Wolbert 1931	F 3 mo	Small intestine loops, other viscera	Whispering respiration. Cyanosis since 3 weeks of age. Death
Magnuson 1934	F 60	J. Jejunum	"Circumscribed hemangioleiomyoma, 3 by 6 cm. Anemia, lower abdominal pain, few weeks. Surgical removal but metastasis found in regional nodes. Serosa and edema believed it was hemangioendothelioma
May 1930		Stomach	
Mac Callum ( ) 1930		Small intestine	Recurrent nodules. Metastasis to liver
Smith and Broders 1933	F 69	Anus	
Smith and Broders 1933	F 48	Rectum	

## Endothelioma

Jorgensen 1931		Stomach	Lesion 15 by 10 by 8 cm. Dahlgren and Chocroff refer to this as case of hemangio- endothelioma
Hawerhans 1896	M 69	Stomach	
Brissaud 1900	34	Stomach	Alcoholic with vomiting, pain, dyspepsia of 6 years duration. Operation
Seebach 1900	M 38	Stomach	Dahlgren refers to this case as possible hemangioendothelioma
Oettinger 1903	M 31	Stomach	Ten years of epigastric distress. Epigastric fullness and vomiting, 3 years. Operation
Cummet 1902		Stomach	This case excluded by Bagger, Jorgensen, Dumas, and Dahlgren. It appears uncertain as to whether deals with an endothelioma

\*Clinical details given in Table 3

TABLE II.—PUBLISHED CASE REPORTS OF VASCULAR LESIONS OF THE GASTROINTESTINAL TRACT ACCORDING TO TYPE—Continued

Endothelioma			
Author year	Sex, age	Location	Remarks
Donath 900		Stomach	
Morris 9		Stomach	Posterior gastrotomy to relieve pyloric obstruction. Under roentgen therapy the growth "apparently disappeared entirely." Patient gained 50 pounds.
Bagger-Jørgensen 79		Stomach	
Fontana 918		Stomach	Lymphangioendothelioma
Glander 929 (cases)		Stomach	
Baumbeck 930	M 60	Stomach	
d'Aragón 933		Cecum	Symptoms simulating acute appendicitis
Lehman 935		Intestine/liver	Diffuse thickening of the entire intestine with secondary growths in the liver
Kaposi's sarcoma			
Wiatralis and Boggs 9	M 67	Esophagus, stomach, duodenum, small and large bowel	Malignant degeneration of visceral hemangiomas. Hematemesis. Death. Also skin, liver, spleen involved. Alleged by many authors to have been a case of Kaposi's sarcoma.
Kaposi 87		Bowel lesions	Commented on bloody diarrhea in his 2 necropsy cases
Sternow 1897 (cases)		Stomach, colon	Pancreas and kidney also involved
Mérian 900		Stomach, small intestine, colon	
Della F. Vera 9 (cases)		Stomach and intestines	Eight years' duration. Trachea and bronchi also involved
McHard and Weisman 935	M 8	Stomach and intestines	Six year progressive appearance of cutaneous lesions. No known gastrointestinal symptoms. Neck, legs, urinary bladder involved
Kennedy 933	M 33	Stomach, duodenum, ileum, cecum, and rectum	First nodule appeared on toe. Progressive appearance for 5 years. Back, face, extremities involved. Death
Szymanski 94	M 6	Stomach, duodenum, entire small intestine	Lumps on extremities for years. Nausea and abdominal cramps. Death
Leibenthal 930		Intestines, extremities	Mentioned visceral involvement. No details given
Grigorjew 974		Small intestine	Extremities also involved
Prohl 918		Small and large bowel	Clinical disturbance of gastrointestinal tract before skin lesions noted
Agutter and Finkle 947		Ileum	Lesions of foot for .5 years. Roentgen therapy: progress of disease not altered
Bowman 933			Skin lesions present 6 years. Gastrointestinal hemorrhages, 2 years. Death
"Benign" metastasizing hemangioma			
Ullman 1896	F 40	Intestines, rectum	"Capillary angiomas. Purple lesions of face developed. Biopsy: "Cavernous angioma. Four years later onset of bronchial and gastric hemorrhage. Death
Staman 189	F 400.	Small intestines	Angioma simplex: endothelial hyperplasia. Death during operation for attempted extirpation. Skin, lungs, cerebral cortex involved
Ullmann 900	F 49	Intestines	"Cavernous hemangioma. Death from infection. Skin, other internal organs involved
Konjetny 9	F 4	Intestine	"Histologic appearance of cavernous hemangioma. Lesions in the lung, liver and intestines considered metastatic. Death



TABLE II.—PUBLISHED CASE REPORTS OF VASCULAR LESIONS OF THE GASTROINTESTINAL TRACT ACCORDING TO TYPE—Continued

Angiosarcomas			
Author year	Sex, age	Location	Remarks
Philipsen 1901		Stomach, appendix, colon	Thirty-four months duration. Eye, nasopharynx, spleen, testicle also involved
Thom 1904	M 36	Stomach	Large abdominal tumor palpated. Abdominal exploration of internal hemorrhage. Death. Spleen, liver lungs also involved
Berry ( ) 1914	F 35	Stomach	Sarcomatous angiosarcoma. Abdominal pain, few months. Operation
Mahelkoff 1933	F 34	Stomach	Pain in right quadrant, anorexia, jaundice months. Death. Primary lesion in liver with metastases to lungs and stomach
Friedrich and Coe 35	M 41	Intestines	Pain in right shoulder 4 months. Biopsy. Radium therapy. Died with extensive metastases to lungs, spleen, liver and intestines
Phillips and Rivers 1930	F 33	Stomach	Angiosarcoma. Discussion, section on pathologic diagnosis

There are few forms of new growth about whose nature there has been so much divergence of opinion as is evidenced in the literature on malignant vascular tumors.

Classification of these tumors which involve the gastrointestinal tract may be made into five main groups: endotheliomas, with no further descriptive terminology; hemangioendotheliomas; benign metastasizing hemangomas, considered by many pathologists as malignant Kaposi's sarcomas; and angiosarcomas.

**Endotheliomas.** In 1869 Golgi introduced the term endothelioma to describe a group of tumors which form endothelium-lined spaces. Soon after this original article was published a large number of tumors were classified under this title; however as the genesis of many epithelial purely sarcomatous, and mixed-cell types of tumor has been worked out, this terminology has been retained for only a few lesions.

This type includes those whose obvious morphologic features determine the true endothelial nature of the cells, and any tumor now classified as an "endothelioma" requires a certain cell type of mesenchymal origin, must be capable of forming intercellular mesenchymal fibrils, and must have the inherent growth characteristic of demonstrating an alveolar nature or rudimentary lumen-forming elements.

No malignant vascular lesions of the gastrointestinal tract are now classified solely under this heading at the Mayo Clinic; however a large group of tumors of historical and pathologic interest are thus described in the literature and will be reviewed in this and another section of the study.

Data on 61 malignant vascular tumors of the gastrointestinal tract have been collected in this

review. Fourteen of the lesions reported in the literature were termed "endothelioma." Twelve were located in the stomach; 1 was in the cecum, and 1 was vaguely described as occurring in the intestine and liver.

Two patients with endothelioma of the stomach experienced a sensation of epigastric pressure and fullness for from 6 to 10 years before pyloric obstruction developed.

A gastric resection was followed by complete relief of the symptoms in 2 cases, whereas in a third case the tumor was considered too extensive for removal and gastroenterostomy was undertaken to avoid further obstructive symptoms. The endothelioma in the third case allegedly disappeared after roentgen therapy.

An endothelioma of the cecum caused symptoms simulating acute appendicitis and was removed.

Perhaps the histopathologic classification of these tumors would be modified if the tumors were re-examined with more recent and rigid criteria; therefore any conclusions regarding methods of treatment and prognosis must necessarily be limited.

**Hemangioendothelioma.** The majority of malignant tumors which form vascular tubes, which have endothelial cells in their basic stroma, and which demonstrate aggressive growth characteristics, including metastasis, were termed "hemangioendotheliomas" by Mallory in 1908.

Stout, in 1943 listed the modern theories of histogenesis and pathology which assist in the classification of hemangioendotheliomas.

In the gastrointestinal tract hemangioendotheliomas are usually situated in the submucosa, they are lobulated; they are accurately delimited with alternating soft and firm regions, and they some-

times present areas of degeneration. In the stomach and colon they tend to be pedunculated and may extend into the lumen for a distance of 2 or 3 cm.

The histopathologic features of these human gastrointestinal angiosarcomas include those of vascular tumors and sinuses lined by atypical fusiform and oval shaped endothelial cells which contain scattered mitotic figures together with occasional giant cells and a delicate fibrous framework which may be clarified by use of the Gomori reticulum stain. The highly anaplastic hemangioendotheliomas contain numerous mitotic figures and exhibit an extreme degree of atypical endothelial hyperplasia characterized by closely packed cords or masses of cells without evidence of capillary or sinus formation.

Most authors agree that metastatic lesions from hemangioendotheliomas occur first in the regional lymph nodes and because of this fact, together with the definite tendency toward encapsulation, there is increased opportunity for their complete surgical eradication with a more favorable prognosis.

**Incidence and distribution.** The vascular lesions classified in this group represented 35 per cent of all malignant tumors encountered in this review. They were found in every segment of the gastrointestinal tract although a large majority appeared in the stomach and small intestine.

**Symptomatology, treatment, and prognosis.** The symptoms produced by hemangioendotheliomas, like those of the other vascular tumors which involve the gastrointestinal tract, depend to a large extent on the location of the lesion. The treatment as well as the prognosis is also conditioned by the location and by the grade of malignancy.

The hemangioendotheliomas involving the esophagus produced severe dysphagia, progressive malnutrition, and death following perforation and mediastinitis.

The average age of the 9 patients with hemangioendotheliomas of the stomach was 48 years. Four patients were under 32 years of age.

Anorexia, weight loss and vague symptoms of so-called indigestion were noted in 6 cases while gastric bleeding, severe anemia and associated progressive weakness were observed in 8 others. The average duration of symptoms was more than 3 years in 6 of the cases while in the other 3 cases the patients were examined before their symptoms had been present for a year.

Local excision of the tumor was possible in 6 cases, while a partial gastrectomy was undertaken in 2 others.

Six patients were followed up carefully and 3 of these were free of symptoms more than 20 years after removal of the tumor. The fourth patient was living and well 4 years after surgical treatment, while the fifth patient died as the result of another disease 7 years after removal of the gastric lesion.

In 4 patients with hemangioendothelioma of the duodenum or small intestine, signs and symptoms of obstruction developed while in 3 bleeding from ulcerations on the mucosal surface of their tumor occurred.

In only 4 of the 6 cases of hemangioendothelioma of the duodenum or small intestine was exploration performed and the lesion excised. One patient died of surgical complications and 2 patients were not followed up over a long period of time.

Rectal swelling, tenesmus and bleeding were observed in 2 patients with hemangioendotheliomas located just above the anal margin. The first patient was living and well with no rectal complaints 13 years after local excision and radium therapy for a low grade lesion (Broders classification). The second patient was found to have fluid in the thorax from a metastatic grade 3 hemangioendothelioma of the rectum. He failed rapidly in spite of local radium packs applied to the rectal lesions and extensive roentgen therapy over the chest.

Many of the hemangioendotheliomas appear in young adults who may give a history of relatively long duration of symptoms. The prognosis is excellent for patients who have low grade lesions which are surgically excised and followed by extensive radiation therapy. The higher grade lesions metastasize early to both local and distant parts of the body and are not cured after removal of the primary growth or with extensive adjunctive radiation therapy.

**Benign metastasizing hemangiomas.** Another group of vascular tumors which have given rise to a considerable amount of discussion in the literature are the so-called "benign metastasizing hemangiomas." They are characterized by extensive metastasis in spite of a seemingly benign histologic pattern. The existence of such a group has an intimate bearing on the question of the essential similarity of all benign and malignant processes. Some authors have attempted to discredit altogether the criteria by which these lesions are classified as benign.

**Pathogenesis.** Lubarsch raised the question whether there is a primary growth in these neoplasms, or whether there are independent growths with multiple foci of origin.

TABLE III.—ABRIDGED REPORT OF 106 CASES OF VASCULAR LESIONS OF THE GASTROINTESTINAL TRACT BY TYPE

## Capillary hemangioma, simplex or single

Case	Sex, age	Location	Remarks
	M 70	Esophagus	Lesion by 5 cm. Increasing dysphagia and weight loss for 3 months. Esophagoscopy biopsy and radical resection. Death 4 months later from hemorrhage obstructing esophagus
	M 30	Stomach	Lesion by 2 by 5 cm. Worsened, followed after meals, and recurrent vomiting, 12 months. Outstomachy local excision of hemangioma. No further symptoms, 12 years
3	M 53	Sigmoid, colon	Lesion by 3 by 1 cm. History of ulcerative colitis. No recurrence, 3 years. Proctoscopy excision of hemangioma, base fulgurated. No further symptoms, 13 years
4	M 67	Cecum	Lesion by 2.5 by 1 cm. Death from hypertension, arteriosclerosis, and hemiplegia. Hemangioma incidental finding at autopsy
5	M 68	Rectum	Lesion by 2.5 by 1 cm. Sensation of pressure in rectum, 10 months. Hemangioma 1 cm. above dentate line excised with clamp and cautery. No recurrence, 6 years
6	F 48	Rectum	Lesion by 1 by 1 cm. Fell on picket fence, 10 days previous and perianal area at 6 years of age. Rectal tenosinus developed at 27 years of age. Excision of bluish colored rectal growth. No recurrence, 4 years

## Mixed capillary and cavernous hemangioma

7	M 8	Esophagus, jejunum	Lesion by 3 by 1 cm. Incidental finding at autopsy. Death from complications following transverse colic prostatic resection
8	M 67	Stomach	Lesion 4 by 2.5 by 5 cm. atrophy of stomach. Pain and sense of fullness in epigastrium, 15 pound weight loss, 10 months. Sleeve resection of stomach. Death 4 years later from chronic nephritis. No recurrence of hemangioma
9	M 68	Stomach	Lesion by 1 by 1 cm. Anorexia and 10 pound weight loss, 6 months. Transgastric exploration, gastric Polys gastric resection. No symptoms or roentgenographic evidence of recurrence, 6 years
10	M 39	J. jejunum	Lesion 1.5 by 1.5 by 1 cm. Movable, tender firm mass palpated in abdomen. Local excision of hemangioma at jejunoenterostomy border
11	M 74	Jejunum	Lesion 1.5 by 1.5 cm. Incidental finding at autopsy. Death from myocardial infarction 7 days after suprapubic prostatectomy
	M 15	Jejunum	Lesion 3 by 1 by 1 cm. Three severe gastrointestinal hemorrhages with no other symptoms, 3 years. Roentgenogram of small intestine tumor observed. Resection. No further hemorrhages, 4 years
12	F 39	Ileum	Lesion by 1 by 1 cm. Adhesive band between cecum and ileocecal tube produced obstruction of ileum. Hemangioma based on resected ileum. No further gastrointestinal symptoms, 12 years
14	F 18	Appendix	Lesion 0.5 by 1 cm. Recurrent right lower abdominal pain, 3 years. Appendix resected and covered with adhesion. Appendectomy and left oophorectomy. No further symptoms
5	F 39	Rectum	Lesion 3 by 1 by 1 cm. Sensation of pressure and swelling in perineum, 6 years. Excision of hemangioma in rectum and rectovaginal septum. No recurrence, 5 years
16	M 46	Rectum	Lesion by 0.5 by 1 cm. Recurrent pain from hemorrhoids and sensation of obstruction to rectal outlet, 7 years. Hemorrhoidectomy and local excision of polypoid hemangioma. No further rectal complaints, 4 years

## Cavernous hemangioma, multiple phlebotomized (type small cavernous)

7	M 57	Esophagus, small intestine	Incidental finding at autopsy. Death from pneumonia, central nervous system syphilis and hypertension
18	M 66	Esophagus, small intestine, colon	Incidental finding at autopsy. Death from pneumonia, complication of suprapubic prostatectomy
19	M 60	Esophagus, small intestine	Incidental finding at autopsy. Death from myocardial infarction
20	M 39	Esophagus, stomach, small intestine, colon	Incidental finding at autopsy. Death from streptococcal septicemia secondary to carbuncle of neck
21	M 73	Esophagus, ileum, colon	Incidental finding at autopsy. Death from unresorbed lobar pneumonia. Left auricular appendage of heart contained hemangioma
	M 77	Esophagus, small intestine	Incidental finding at autopsy. Death from hypertension, coronary atherosclerosis, and infarction of left ventricle
22	M 71	Duodenum, small intestine	Incidental finding at autopsy. Death 10 months after prostatectomy of pulmonary embolism
24	M 43	Duodenum, small intestine	Incidental finding at autopsy. Death from syphilitic arthritis
25	M 36	Duodenum, small intestine	Incidental finding at autopsy. Combined abdominal-peritoneal resection for adenocarcinoma of rectum. Death from generalized peritonitis
26	M 60	Duodenum, small intestine	Incidental finding at autopsy. Death from prostatic hypertrophy, pyelonephritis, and uremia

TABLE III.—ABRIDGED REPORT OF 106 CASES OF VASCULAR LESIONS OF THE GASTROINTESTINAL TRACT BY TYPE—Continued

Cavernous hemangioma, multiple poliblectasia type (small cavernous)

Case	Sex, age	Location	Remarks
27	M 64	Duodenum, small intestine, colon	Incidental finding at autopsy Death from hypertension and uremia
28	M 74	Duodenum, small intestine	Incidental finding at autopsy Partial gastrectomy for ulcerating adenocarcinoma. Death from postoperative pneumonia and peritonitis
29	M 71	Duodenum, small intestine	Incidental finding at autopsy Death from multiple myeloma and lobar pneumonia
30	M 73	Duodenum, small intestine	Incidental finding at autopsy Death from aortic endocarditis and dilatation of left ventricle
31	M 43	Jejunum	Hematemesis, melena, epigastric pain, years. Posterior gastroenterostomy for duodenal ulcer. Hemangioma seen during surgical exploration. No further symptoms, 23 years
32	F 68	Small intestine	Incidental finding at autopsy Death from pulmonary embolism 8 days after radical amputation of left breast for adenocarcinoma
33	M 63	Small intestine	Incidental finding at autopsy Death from hemorrhage from duodenal ulcer
34	M 78	Small intestine	Incidental finding at autopsy Death from carcinoma of prostate and pulmonary metastasis
35	M 60	Small intestine	Incidental finding at autopsy Partial gastrectomy for adenocarcinoma. Death from duodenal fistula and peritonitis 6 days after operation
36	M 41	Small intestine	Incidental finding at autopsy Death from gastroenterostomy and pneumonia 9 days after antrum excision of gastric ulcer and posterior gastroenterostomy
37	M 63	Small intestine	Incidental finding at autopsy Death from generalized arteriosclerosis angina pectoris, and coronary sclerosis
38	M 6	Small intestine	Incidental finding at autopsy Death from carcinoma of pancreas
39	M 46	Small intestine	Incidental finding at autopsy Death 7 days after suprapubic cystostomy and insertion of radium needles for carcinoma of bladder. Bronchopneumonia and empyema
40	M 45	Small intestine	Incidental finding at autopsy Death from pulmonary abscess 3 months after tooth extraction
41	M 69	Small intestine	Incidental finding at autopsy Death from septicemia and multiple lung abscesses 18 days after suprapubic cystostomy and diathermy for squamous cell epithelioma of bladder
42	M 56	J. jejunum, ileum, rectum	Incidental findings at autopsy Death from bronchopneumonia and empyema
43	M 55	J. jejunum, ileum	Incidental findings at autopsy Death from peritonitis 9 days after resection for obstructive adenocarcinoma in the retrocaecum
44	M 60	Jejunum, ileum	Incidental finding at autopsy Death from bilateral pulmonary edema and bronchopneumonia 8 days after right pelvicthoracotomy. Bilateral sigmoid calculus
45	M 65	Small intestine, colon	Incidental finding at autopsy Death from pericardial aneurysm and fatty changes in myocardium
46	M 47	J. jejunum	Incidental finding at autopsy Death from local peritonitis 5 weeks after resection for obstructive adenocarcinoma of transverse colon
47	M 44	Small intestine	Incidental finding at autopsy Death from adenocarcinoma of stomach with metastasis to liver
48	M 70	Small intestine	Incidental finding at autopsy Death from severe dysphagia and bronchopneumonia after ingestion of "lysol"
49	M 64	Stomach, duodenum, small intestine	Incidental finding at autopsy Death from coronary occlusion and infarction of left ventricle
50	M 68	Small intestine	Incidental finding at autopsy Death from adenocarcinoma of rectum and perforation of duodenal ulcer
51	M 66	Small intestine	Incidental findings at autopsy Death from coronary sclerosis and infarction of left ventricle
52	M 53	Small intestine	Incidental finding at autopsy Death from cerebrovascular accident 7 days after transurethral prostatic resection
53	M 60	Small intestine	Incidental finding at autopsy Death from hypertension and cardiac decompensation
54	F 49	Small intestine	Incidental finding at autopsy Death from metastasis from adenocarcinoma of right breast

TABLE III—ABRIDGED REPORT OF 106 CASES OF VASCULAR LESIONS OF THE GASTROINTESTINAL TRACT BY TYPE—Continued

Cavernous hemangiomas, multiple phlebotomias type (small cavernous)

Case	Sex, age	Location	Remarks
35	M 41	Small intestine	Incidental finding at autopsy. Death from tuberculous meningitis
36	F 54	Small intestine	Incidental finding at autopsy. Death from Korsakoff's psychosis and barbiturate poisoning
37	M 64	Duodenum	Incidental finding at autopsy. Death from perforated gastric ulcer and peritonitis
38	M 47	Small intestine, cecum, rectum	Incidental finding at autopsy. Death from multiple brain abscesses and acute cerebrosplenic meningitis
39	M 69	Jejunum	Incidental finding at autopsy. Death from coronary atherosclerosis and infarction of the left ventricle
40	M 73	Jejunum	Incidental finding at autopsy. Death from psychosis and multiple infarcts of basal nuclei of midbrain
41	M 4	Jejunum, ileum	Incidental finding at autopsy. Death from chronic asthmatic bronchitis and pulmonary emphysema
42	M 6	Small intestine	Incidental finding at autopsy. Death from myocardial degeneration and peritonitis
43	F 43	Small intestine	Hematemesis and melena with associated syncope 3 years. Diagnostic procedures did not reveal any lesion in gastrointestinal tract or blood dyscrasia. Abdominal exploration and duodenotomy revealed only hemangiomas. Bowel resection given as decreasing amounts for 4 years with no return of hemorrhage
44	M 39	Small intestine	Recurrent tarry stools, 1 year. Cholelithiasis and cholelithiasis. No cause for melena observed except vascular tumor. Death from acute yellow atrophy of liver at 4 months
45	M 60	Small intestine	Weight loss and weakness, 10 months. Tarry stools, 10 days. Hemangiomas observed during abdominal exploration and repair of parastaphylar diaphragmatic hernia. No further melena, 1 year
46	M 6	Small intestine	Incidental finding at autopsy. Death from hypertrophic pseudomembranous cystitis and urethritis
47	M 7	Small intestine	Incidental finding at autopsy. Death from cerebral arteriosclerosis and infarction of brain
48	F 29	Small intestine	Recurrent abdominal cramps and blood by stool, 7 weeks. Abdominal exploration during which hypomelic small hemangiomas were observed throughout the small intestine. Extensive melena observed post-op. Evidence of further chronic blood loss, 1 year
49	F 66	Jejunum	Incidental finding at autopsy. Death from pneumonia following amputation of right breast for adenocarcinoma

## Cavernous hemangiomas, simple polypoid type

50	M 6	Esophagus	Lesion by 1 by 1 cm. Increasing dysphagia and 5 pound weight loss, 6 months. Esophagoscopy. First biopsy cavernous hemangioma. Second biopsy tissue similar to first biopsy as well as adenocarcinoma. Radio tube therapy. Death in 6 months
51	M 34	Stomach	Lesion by 4 by 1 cm. Hematemesis, epigastric tenderness, and vague gastrointestinal distress, 1 year. Partial gastrectomy for tumor protruding into duodenum. Excellent health, 1 year
52	F 37	Duodenum	Lesion 1 by 4 by 1 cm. Four episodes of nausea, hematemesis, melena, vertigo, and weakness, 1 year. Erosion of pyloric sphincter anterior wall of duodenum and hemangioma. No gastrointestinal symptoms, 1 year
53	F 73	Duodenum	Lesion 1 by 7 cm. Incidental finding at autopsy. Death from cerebrovascular accident
54	M 71	Ileum	Lesion 1 by 4 cm. Incidental finding at autopsy. Death from chronic lymphatic leukemia
55	M 58	Jejunum	Lesion by 1 by 3 cm. Incidental finding at autopsy. Death from hypertension, arteriosclerosis, hypertrophy of prostate, and uremia
56	M 7	Jejunum	Lesion 1 by 1 by 1 cm. Incidental finding at autopsy. Death from emphysema 5 days after partial duodenectomy for bleeding duodenal ulcer
57	M 34	Ileum	Lesion by 1 by 1 cm. Incidental finding during operation for removal of granulomatous ulcer of cecum
58	M 34	Jejunum	Lesion by 1 by 4 cm. Incidental finding at autopsy. Death from peritonitis 30 days after resection for obstructive adenocarcinoma of the transverse colon
59	F 39	Jejunum	Lesion 4 by 1 cm. Incidental finding at autopsy. Death from cardiac decompression
60	F 66	Jejunum	Lesion 4 by 1 cm. Incidental finding at autopsy. Death from primary carcinoma of the gall bladder

TABLE III.—ABRIDGED REPORT OF 106 CASES OF VASCULAR LESIONS OF THE GASTROINTESTINAL TRACT BY TYPE—Continued

## Cavernous hemangiomas, simple polypoid type

Case	Sex, age	Location	Remarks
8	M 63	Blenn	Lesion 1 by 1.5 cm. Incidental finding at autopsy. Death from hypernephroma of left kidney
9	F 50	Appendix	Lesion 6 by 6 mm. Incidental finding in appendix which was removed at same time as cholecystectomy for gangrenous cholecystitis
83	F 53	Sigmoid	Lesion 1 by 1 cm. Incidental finding at autopsy. Death from senile psychosis
84	M 26	Sigmoid	Lesion 5 by 3 cm. Extensive cavernous hemangioma of penis, scrotum, and perineal margin since birth. Local radium applications, 1 year of age. Two severe rectal hemorrhages (1 re years of age) a bleeding to stool was allegedly removed from rectum. Return of bright red blood on surface of each stool, 6 months. Weakness and anemia with no pain or cramps. Transcatheter occlusion of hemangioma. Third hemangioma palpated in right lobe of liver. N further bleeding, 1 year

## Cavernous hemangiomas, diffuse expansive type (single contiguous)

85	F 50	J jejunum	Lesion 7 by 7 by 3 cm. Recurrent symptoms and signs of subacute intestinal obstruction together with abdominal mass, 1 year. Resection of 3 cm. of jejunum and contiguous hemangioma. N further symptoms, 4 years
86	M 33	Entire small intestine, colon, rectum	Recurrent severe intestinal hemorrhages requiring 5 blood transfusions, 0 years. Partial gastrectomy done elsewhere with return of hemorrhage. Ileocolic anastomosis, resection of 3 feet of ileum and right colon done elsewhere with return of hemorrhage. Abdominal exploration revealed entire small and large intestine covered with cavernous hemangioma. Patient could not have survived extensive resection necessary to remove hemangioma. Recurrent hemorrhages, 3 years
87	F 47	Cecum, appendix	A diffuse cavernous hemangioma which involved the entire cecum and appendix was observed during cholecystectomy for cholecystitis and cholelithiasis. No gastrointestinal bleeding in 1 year interval since operation
88	F 7	Sigmoid, rectum, bladder	Recurrent hemorrhages from rectum and bladder beginning 16 months after birth. Death from severe rectal hemorrhage in spite of local packing and supportive therapy
89	F 45	Colon	Lesion 4 by 4 by 4 cm. Recurrent abdominal cramps, increasing constipation, persistent tender mass in left lower quadrant, 6 years. Blood coating surface of stool 4 months. Cecostomy followed by first and second stage Milesian resection. Living and well 1 year after operation

## Cavernous hemangiomas, multiple diffuse type (noncontiguous)

90	M 28	Sigmoid, rectum, kidney	Constipation since birth. Alternating constipation and diarrhea, pain in rectum, blood / stools, 1 year of age. Three episodes of gross hematuria. Roentgen therapy on basis of possible trapped hypernephroma. Returned 1 year later with extreme weakness, pallor and anemia from severe rectal hemorrhage. Transfusions. Radium pack. Shock and death from hemorrhage
91	F 24	Sigmoid, rectum, bladder, labia, leg	Recurrent hematuria, rectal hemorrhages and swelling of left leg since infancy. Suprapubic exploration and cauterization of bleeding points during episodes of severe hematuria. Rectum, sigmoid, and bladder extensively involved with cavernous hemangioma. Rectal and urinary hemorrhages continued for 3 years
92	M 33	Colon, liver	Lesion 4 by 1 cm. Incidental finding at autopsy. Death from metastatic adenocarcinoma from the rectum 1 year after combined abdominoperineal resection

## Hemangioendotheliomas

93	F 76	Esophagus, lower third	Grade 1 lesion 1 by 1 cm. Fullness in throat and esophagus without dysphagia or hoarseness, 1 year. Progressive dysphagia and chest pain, 6 weeks. Radiography. Biopsy and dilatation with No. 41 F bougie. Minimal cautery therapy through two portals. Death in 1 month
94	M 43	Stomach	Grade 1 lesion 4.5 by 4 by 3 cm. Epigastric pain and soreness relieved by alkalies, 8 years. Knife excision of ulcer crater and posterior gastrectomy. Free of symptoms, 3 years. Returned with dyspepsia on enuresis, weakness and secondary anemia, 4 years. "V" resection of lesser curvature and tumor. Death 7 years later from cerebrovascular accident. N recurrence of tumor
95	F 5	Stomach	Grade 1 lesion 1 by 1 cm. Indigestion for 4 years. Free of symptoms, 1 year. Constant midepigastric soreness not relieved by food or alkalies, 1 year. Severe anemia, weakness, and soiled loss of weight, 4 months. Gastrectomy with knife excision of tumor and surrounding gastric mucosa. No further gastrointestinal symptoms, 30 years
96	M 50	Stomach	Grade 1 lesion 4 by 3 by 3 cm. Weakness, weight loss, and tarry stools, 1 year. Free of symptoms, 0 years. Return of tarry stools and midepigastric pain, 4 months. Knife excision of tumor and posterior gastrectomy. No further gastrointestinal symptoms, 1 year
97	F 3	Stomach	Grade 1 lesion 4 by 3 by 3 cm. Weakness, tarry stools, and anemia, 1 month. Free of symptoms for 3 years. Recurrent episodes of anemia, 1 month. Freely movable tender epigastric mass. Gastric resection (posterior Polya). Excellent health, 22 years after operation
98	M 15	Stomach	Grade 1 lesion 7 by 6 by 6 cm. Severe hematemesis and melena, 3 months. Gastric resection (posterior Polya). Postoperative coagulation therapy. Death from metastases, 6 years after operation
99	M	Stomach	Grade 1 lesion 7 by 6 cm. Tarry stools, 1 month. N symptoms for 1 year. Return of tarry stools and epigastric pain, 1 week. Abdominal exploration and biopsy done elsewhere. Patient refused further operation. Advised to leave roentgen therapy 1 hour. Could not be located 1 year later

\*Broders classification.

TABLE III.—ABRIDGED REPORT OF 106 CASES OF VASCULAR LESIONS OF THE GASTROINTESTINAL TRACT BY TYPE—Concluded

Hemangiomas of the Gastrointestinal Tract			
Case	Sex, Age	Location	Remarks
100	M 20	Stomach	Grade lesion 5 g by 3 cm. Freely movable abdominal mass 6 months. Tumor detached from posterior wall of pyloric antrum. Postoperative roentgen therapy. No evidence of recurrence 4 years after operation.
101	F	Duodenum	Grade lesion 5 g by 1 cm. Vomiting with any dietary indiscretion. years. Cramp-like abdominal pain. Transabdominal excision of tumor. No evidence of recurrence, 4 years after operation.
102	M 59	Terminal ileum, mesentery	Grade lesion 5 g by 1 g by 1 cm. Recurrent lower abdominal pain, dark stools and 3 pound weight loss, months. Tumor mass in right lower part of abdomen. Two-stage (transverse colostomy and resection of right part of colon. Massive doses of postoperative roentgen rays. Death from metastasis, 14 months after operation.
3	M 13	Colon	Grade lesion. Appendectomy and ileocectomy done elsewhere for "Defile." Return of abdominal pain and masses in 3 months. Abdominal exploration and biopsy of nodular implants, distal ileum, and peritoneum. Many atypical endothelial cells separated from lymphatics. Extensive roentgen therapy to chest and abdomen. Returned 3 years later with no evidence of abdominal mass, masses, or hydrothorax.
104	M	Appendix	Grade lesion 8 g by 8 g by 6 mm. Recurrent upper abdominal pain, dark stools, weakness, 6 months. Abdominal exploration demonstrated no cause for intestinal bleeding. Small diaphragmatic hernia. Appendectomy. Death at home during convalescence. years after abdominal operation.
05	F 69	Rectum	Grade lesion 1 g by 1 cm. Rectal prolapse. Sigmoidoscopic examination did not reveal any lesion for 3 years later postoperative polypectomy which produced three large. Kaposi's cancer, non-dilated, anorexia and area (cervix) base small) lateral lymphatic. Tumor and thirty malignant hours of radiation applied to breaking wound. No return of tumor. 3 years after operation.
106	F 17	Rectum	Grade lesion 5 g by 1 g by 1 cm. Sleeping with delirium, rectal transverse, ribbed-like stools, pain, anorexia, weight loss, persistent cough, 6 weeks. Examination revealed encapsulated polypoid mass, adenoma mass, poor with hyperplasia and an irritating lesion in the lower third of the rectum. Superficial. Local resection applied to tumor, roentgen therapy to chest. Patient failed rapidly 3 months. Death.

Bridges classification

Robinson and Castleman, in 1936 stated that there were only 4 apparently authentic cases of this condition which had been reported respectively by Borrmann in 1907, Shennan in 1914, Ewing in 1919, and by Geschickter and Keeney in 1935. Robinson and Castleman added 1 similar case of their own and separated the cases of Wright, Hall, and others into a group they called "metastasizing hemangiosarcomas." They also called another group "malignant," which was characterized by occurrence in children, a local invasive tendency, hemorrhage, and death.

Borrmann in discussing his case expressed the opinion that the presence of metastasis could no more be used to determine definitely the benign or malignant character of the process than could, for example, the absence of a capsule, rapid growth or invasiveness, which are not exclusively benign or malignant properties. Shennan wondered whether the histologic, rather than the clinical criteria were not at fault. Ewing considered the "benign metastasizing" angiosarcoma a borderline entity and described it as possessing certain peculiar features of malignancy. Jaffe expressed the thought that, because of their infiltrative growth and stroma of undifferentiated mesenchyme these lesions cannot be considered histologically benign. Stout, in 1943 reviewed all the reports on cases of "benign metastasizing hemangioma" and included the report of a detailed examination of Robinson

and Castleman's slides. His final conclusion was that they all show atypical endothelial and very free vascular anastomosis which definitely bring them into the class of hemangiomas.

In only 4 cases of "benign metastasizing hemangioma" in the literature was involvement of the gastrointestinal tract proved by biopsy. A summary of the data in these cases is given in Table II. These 4 vascular tumors involving the gastrointestinal tract might well be classified as hemangiomas if we could review the histopathologic details and include modern concepts of metaplasia, atypical mitotic figures, and evidence of invasion. On the other hand, one cannot help but feel that the existence of multiple primary benign hemangiomas rather than a metastasizing process could explain the origin and distribution of these lesions.

*Kaposi's sarcoma* In 1872 an Austrian dermatologist Kaposi, described the lesions now generally called "Kaposi's sarcoma." He named it "idiopathic multiple pigmented sarcoma." In 1894 he changed the designation to "sarcoma idiopathic multiplex hemorrhagicum."

The early pathologists were uncertain as to whether this was an inflammatory or a neoplastic process. Some still believe that the tumor is implanted on an inflammatory base whereas most authors now feel that the process is a neoplasm of low grade malignancy.

More recent authors (48, 49, 66-236) have attempted to reclassify the disease according to their theories as to its cell origin. Since the tumor contains blood vascular elements or cavernous blood filled spaces, and since many pathologists consider certain of its histopathologic features to be identical with those designated as "hemangioendothelioma," it will be considered in the same general group with other malignant vascular lesions which are found to involve the gastrointestinal tract.

The disease has a tendency to develop first on the extremities as a unilateral lesion, to become bilaterally symmetrical, and then to progress to a generalized condition involving most often the gastrointestinal tract. It appears to be especially prevalent in men of Italian or Gallican birth but, as Doerfler pointed out, there appears to be a geographic rather than a racial distribution since the vast majority of cases originate in Russia, Poland and Northern Italy.

**Histopathology** The histopathology of this lesion has been variously interpreted as being that of a sarcoma arising in angiomata of the skin, proliferation of the interstitial connective tissue and endothelium, a disturbance of the "monocytogenic" function of the reticuloendothelial system, hemangioendothelioma and malignant proliferation of the perithelial cells, and, recently several cases of leucocytic dyscrasia have been mentioned in connection with this disease. Various histopathologic features may be observed in different lesions of the same individual and this may account for many of the varied histogenic interpretations.

Any cell type classification must explain how vascular channels predominate in some areas, fibrous tissues in others, and endothelial hyperplasia in most microscopic fields.

Choussier and Ramsey (49) in 1940, circumvented the problem of multicellularity by suggesting that all of the various types might arise from the reticuloendothelial system.

The cellular arrangement of the older lesions resembles that of a low grade hemangioendothelioma, and many pathologists consider this tumor as an unusual representative of this group. The apparent male sex linked character of this lesion is, however different from that of the general group of hemangioendotheliomas, in which the incidence is about the same in both males and females. In this connection it is interesting to note that in 365 cases of Kaposi's sarcoma reviewed by Doerfler, all but 21 patients were males.

The most striking feature exemplified by the pathologic anatomy of Kaposi's sarcoma is that

the same changes occur in the viscera as in the skin, this fact, together with simultaneous involvement, points to the possibility that the internal lesions are independent in origin and not truly metastatic. Paolini reported a case in which clinical symptoms appeared in the gastrointestinal tract before lesions could be found in the skin.

**Incidence and distribution** Becker and Thatcher in 1938, found reports of 440 cases in the literature. Twenty-six cases of Kaposi's sarcoma have been proved by clinical history and biopsy of skin lesions at the Mayo Clinic. Four of the patients had vague gastrointestinal symptoms and 2 others had previously had gastric resections before coming to the clinic. In only 1 case was a record of gastrointestinal bleeding noted in the history.

Fourteen cases in which specific mention was made of the presence of Kaposi's lesions in the gastrointestinal tract at autopsy have been reported in the literature.

The complete gastrointestinal tract is involved in many of the cases.

**Symptoms, treatment, and prognosis.** A review of the gastrointestinal symptoms produced by these lesions in the 14 cases referred to in a preceding sentence reveals that 9 reports made no mention of intestinal symptoms however 1 patient had severe hematemesis, 2 patients had tarry stools, 2 mentioned gastrointestinal disturbances, including nausea and vomiting while 1 patient had no known intestinal disturbance during life.

Two commonly accepted forms of treatment are, first, roentgen therapy and, second, administration of a solution of potassium arsenate (U.S.P.) by mouth, or of sodium arsenate by injection. Neither of these methods of therapy has prevented a fatal termination of the disease.

**Angiosarcoma** The sarcomas may be defined as malignant tumors composed of cells of the connective tissue type. A more descriptive term such as "angiosarcoma" indicates the dominant histopathologic pattern of the individual tumor.

The prominent role played by the endothelial cells in all types of sarcoma is demonstrated by the formation of new blood vessels in the connective tissue stroma of the tumor; this is in contrast to the invasion of pre-existing blood vessels by carcinomas.

**Histogenesis and histopathology** The angiosarcomas have a tendency to form many functioning blood channels which are imperfect and immature as compared to the normal vascular substrate of adult organs or tissue. When these spaces become obliterated by proliferating edematous, atypical endothelial cells, growth ceases



and necrosis or various types of degeneration may be seen.

Many writers feel that the term "angiosarcoma" should be reserved for those very vascular tumors in which formed blood vessels, rather than atypical, extremely hyperplastic endothelial-lined blood spaces, are observed.

The etiology of angiosarcoma, as with all forms of malignant lesions, is obscure.

**Incidence and distribution.** Data on 6 cases of angiosarcoma of the gastrointestinal tract were found in this review. Three lesions were thought to have originated in the stomach, while the others were considered as metastatic deposits from other parts of the body.

Freilich and Coe, in 1936 reviewed the reports of 20 cases in the literature over the period from 1918 to 1934, inclusive, and found only 1 case in which they felt that the lesion was primary in the gastrointestinal tract. The lesion in this case allegedly appeared in the jejunum.

**Symptomatology, treatment, and prognosis.** The most prominent symptom of this group of lesions was pain. This occurred first at the site of origin and later at the sites of metastatic lesions.

There have been a few cases cited in the literature in which exploration of the abdominal organs was carried out early enough to permit resection of a primary angiosarcoma before obvious metastasis had occurred.

Röntgen therapy has been of little or no value, and 3 of the 4 patients reported on in detail in the last named study survived only a few months after the onset of symptoms.

#### EXPERIMENTAL PRODUCTION OF MALIGNANT VASCULAR TUMORS

In recent years several different carcinogens have been identified and are used in the experimental production of malignant tumors. Selbie, in 1938, found that radioactive thorotrast injected subcutaneously acts as a foreign body and the resulting constant bombardment of alpha particles stimulates a continuous proliferation of connective tissue. If capillary endothelial cells are involved a hemangioendothelioma will develop. This was found to occur not only at the site of injection, but also in parts of the body distant from the point of initial irritation.

An interesting report was published by White and Stewart, in 1942 indicating that when certain strains of white mice were fed methylcholanthrene there developed precancerous epithelial lesions, adenocarcinomas of the intestine which metastasized to the mesenteric lymph nodes and liver and hemangioendotheliomas which involved

single or in combination the intestine, mesentery and pancreas, and which, in turn, then metastasized to the liver and lungs. A higher incidence of hemangioendothelioma developed in one strain of mice than in others.

Andervont, Grady and Edwards, in 1942, injected 2-amino-5-azotoluene into the subcutaneous tissue of 63 mice. Subsequently 71 hemangioendotheliomas were found in these mice and most of the lesions were within fat deposits in the interscapular region, abdomen or subcutaneous tissues away from the site of injection. These authors stated that the etiology of this predilection for fatty tissue is obscure. Transplants were also successful, 1 tumor being carried for 30 generations. Other investigators have reported induction of hemangioendotheliomas at or near the site of administration of polycyclic hydrocarbons and colloidal thorium dioxide.

#### TREATMENT OF VASCULAR TUMORS

In contrast to the numerous and highly effective methods of treating vascular malformations and tumors of the skin and the mucous membrane of the mouth, tongue, and nasopharynx, the vascular lesions involving the lower part of the gastrointestinal tract are, by virtue of their position, difficult and often impossible to eradicate.

Surface applications of sclerosing agents are not practical for many deep-seated vascular tumors; however, refrigeration with carbon dioxide snow or the injection of sodium morrhuate has a limited application in the treatment of esophageal or rectal hemangiomas.

Pilcution of intraperitoneal vascular tumors with mattress sutures or ligation of their tributary vessels may be followed by progressive necrosis and rupture of the associated hollow viscus. The insertion of hot platinum needles or cautery fulguration has been utilized in a few cases in which danger from future necrosis of vital structures was not an important consideration.

Radium and roentgen therapy have proved valuable in the treatment of many vascular lesions both on the body surface and in the gastrointestinal tract. The effective roentgen and radium emanations produce swelling and degeneration of the endothelial cells.

Pack and Livingston have correlated the histopathologic features of vascular lesions with the amenability of the lesions to roentgen therapy. They stated that the capillary angiomatous of the skin seem radiosensitive; that the bulky cavernous hemangiomas in children tend to be radiosensitive, although there are better forms of treatment, and that the bulky cavernous hemangiomas of

adults are radioresistant except to caustic sclerosing doses.

Bailey and Kiskadden, on the other hand, found that the well differentiated endothelial cells of capillary hemangiomas are resistant to roentgen therapy.

It has been pointed out by MacKee that beta rays are more efficacious than gamma rays for superficial lesions however gamma radiations have given better results than filtered roentgen rays for deeper lesions.

Baensch, in 1938, treated cavernous hemangiomas of the body surface by the implantation of radium needles filtered through platinum and iridium. Excellent results were observed in 303 cases, with no bleeding or necrosis of the hemangiomas.

The mere fact that good results are reported by numerous authors using many methods and types of radiation therapy serves to prove that no single approach is applicable and successful in all cases.

The vascular lesions present special problems in radiation and surgical therapy which depend on the type of tumor and specific location in the gastrointestinal tract. These problems will be considered in the following section of this review.

#### ANALYSIS OF CASES

*Vascular malformations and tumors of the gastrointestinal tract.* Because of the confusion of nomenclature in the literature it is difficult to state the exact incidence of any individual types of either benign or malignant tumors of the gastrointestinal tract.

Geschickter in 1935 reviewed the reports of a large series of tumors appearing in these organs and found reference to 962 malignant tumors during the same period that he collected reports of 178 benign tumors. Six of the 178 benign tumors were angiosarcomas, which accounted for approximately 3 per cent of the benign lesions.

Ackerman in 1937 found only 3 cases of hemangiomas of the gastrointestinal tract during a 10 year period in which 1,200 autopsies were performed.

Geschickter and Keasbey reviewed the data on 570 tumors of the blood vessels found in the surgical and autopsy records of the Johns Hopkins Hospital. They found in this group only 10 vascular lesions which involved either the kidney, spleen, intestines or mesentery.

Kujper in 1936 collected from the literature, reports of 74 vascular tumors found in the gastrointestinal tract, and classified the tumors.

Data on 344 benign and malignant vascular tumors involving the gastrointestinal tract were

collected in our review. Two hundred and eighty three of these lesions were classified as benign while the other 61 were considered malignant thus, approximately 82 per cent of the lesions were benign. One hundred and ten of the 344 cases were encountered in the surgical or autopsy records of the Mayo Clinic these 110 cases occurred among more than 1,400,000 persons. It can thus be estimated that roughly 1 in every 14,000 persons registered at the Mayo Clinic was found to have a benign or malignant vascular tumor involving the gastrointestinal tract.

*Symptoms.* In 66 per cent of all the cases of benign vascular tumor symptoms were mentioned whereas in all of the cases of malignant tumors symptoms were recorded.

*Treatment.* Thirty per cent of the patients with benign vascular tumors underwent surgical treatment, while 31 per cent of the patients with a malignant tumor of the gastrointestinal tract underwent some type of surgical exploration and treatment. Sixteen per cent of the malignant vascular tumors and 5 per cent of the benign vascular tumors were treated by other methods than operation.

*Complications.* Twelve per cent of the patients with benign vascular lesions and 48 per cent of those with malignant vascular lesions were mentioned as having died from some complication of the gastrointestinal tumor. Thirty four per cent of the benign vascular tumors, as opposed to none of the malignant vascular tumors, were mentioned as incidental findings during autopsy.

*Sex ratio.* Watson and McCarthy in their extensive series reported in 1940, cited a definite trend to indicate that benign blood and lymph vessel tumors occur more frequently in females. In their series, 65 per cent of the lesions occurred in females, and this frequency of occurrence was mentioned as a constant feature in the literature. The sex ratio was calculated however on the basis of all lesions, including those which appeared on the surface of the body as well as those in the viscera.

Our review of the lesions appearing in the gastrointestinal tract, on the other hand, revealed a sex ratio of 1 female to 2 males among cases reported in the literature and a slightly higher ratio of approximately 1 female to 3 males in the Mayo Clinic series.

*Vascular malformations and vascular tumors of the esophagus.* Benign tumors of the esophagus are comparatively rare and the majority are amenable to some form of treatment. Malignant tumors, by contrast, are relatively common and very difficult to treat. The vascular lesions of the



Fig. 2. Cavernous hemangioma of the esophagus, multiple phlebectasia type. Note large vascular spaces lined by a single layer of endothelial cells (hematoxylin and eosin  $\times 14$ ).

esophagus constitute a small minority of the aforementioned groups. Esophageal varices are not considered as primary vascular malformations and have not been included in this review.

**Incidence.** Sommer in 1896, and Bennecke in 1906, reported the first cases of multiple cavernous hemangiomas of the esophagus.

Vinson and his co-authors reported, in 1916, on the findings and treatment in a case of capillary hemangioma which was treated through the esophagoscope with a radium tube.

A summary of the data on the reported cases of vascular tumors of the esophagus, presented in Table II is based on the following lesions: 9 benign hemangiomas, 2 hemangioendotheliomas and 1 Kaposi's sarcoma.

One malignant and 9 benign vascular lesions were found also in the Mayo Clinic series and include the following: 1 mixed capillary and cavernous hemangioma, 6 multiple cavernous hemangiomas (Fig. 1), 1 simple polypoid cavernous hemangioma, and 1 hemangioendothelioma.

**Symptoms.** The symptoms from vascular tumors of the esophagus include slowly progressive dysphagia, regurgitation of food, pain in the thorax extending to the back and accentuated on swallowing, slow starvation, dyspnea if the tumor enlarges to obstruct the trachea, severe pain and subcutaneous emphysema following perforation, and, rarely, severe hematemeses and melena.

Among the benign vascular lesions found in this study 1 tumor perforated the esophagus with ro-

sulting mediastinitis and death, 7 tumors were incidental findings at autopsy and 1 tumor was associated with a carcinoma of the esophagus, which was perforated and caused death, and the hemangioendothelioma produced severe dysphagia, with complete esophageal obstruction and death.

**Differential diagnosis.** The lesions to be considered in the differential diagnosis of vascular neoplasms are the various types of malignant and benign tumors, esophageal varices, cardiospasm, and other demonstrable causes for dysphagia. Telangiectatic lesions are difficult or impossible of recognition, even when a bleeding point is observed, under direct vision with the esophagoscope.

Criteria for the roentgenologic diagnosis of benign and malignant esophageal tumors have been carefully defined; however accurate histopathologic diagnosis can, in the final analysis, be made only by esophagoscopy and biopsy.

**Treatment.** The three methods of treatment for vascular lesions of the esophagus include trans-thoracic surgical extirpation, roentgen therapy through numerous portals, and those procedures adapted for use with the esophagoscope. The method of choice depends on the particular location and type of the lesion.

Surgical extirpation may be carried out through a posterolateral, an upper posteromedial, or a transthoracic approach, depending on the location of the tumor. Polypoid tumors with a small pedicle may be excised, the esophageal continuity being maintained. Lesions occurring in the lower third of the esophagus may be resected in the manner now utilized for carcinomas involving the esophagogastric junction. Extensive malignant lesions involving the upper third of the esophagus might be considered for esophageal resection followed by the establishment of a cervicocervical fistula, the performance of a Beck-Jeanu gastrostomy and, later, reapproximation of the esophagus and stomach through thoracic skin tube grafts. Local invasion and early metastasis along with all attendant hazards of multiple operations and the expense involved in long periods of hospitalization obviate the use of the last-mentioned operative procedure.

Roentgen therapy should be utilized only if treatment through the esophagoscope or thoracic surgical treatment is impractical. In no reported cases were the patients treated by this method alone.

Malignant change is rarely encountered in pedunculated lesions and several of these tumors have been removed through the esophagoscope. Radium packing, adjacent to a hemangioma, has

been reported by Vinson and his co-authors and may be considered in the treatment of very extensive benign vascular lesions; however, its attendant hazards, esophageal perforation or severe hemorrhage, must be remembered.

Moersch, in 1940, reported the injection of esophageal varices with sodium morrhuate. This procedure may be applicable to hemangiomas when encountered in the future.

The series of esophageal vascular malformations and tumors reported in this study is too small for any generalizations as to prognosis, however all 3 patients with symptoms produced by a hemangiomatous tumor were dead within 1 year.

*Vascular malformations and vascular tumors of the stomach.* Vascular malformations and vascular tumors are rarely encountered in the stomach; however their importance is emphasized by a high incidence of severe complications, the frequent occurrence of malignant change, and the satisfactory prognosis after adequate removal.

*Incidence of benign vascular tumors.* Rokitanaky (209) in 1855 alluded to the first gastric hemangioma by stating that 'erectile tumors' may be attached by a broad base; however Lammen, in 1893, gave the first detailed description of a capillary hemangioma found at autopsy.

In 1920 Lemon collected the reports of the first 5 gastric hemangiomas to appear in the literature and added 1 case of his own.

Since this first series of collected cases, numerous reports have appeared in the literature. These are summarized in Table II.

The reported incidence of hemangiomas as compared to other benign gastric tumors has been listed as between 1.6 and 14.7 per cent. This discrepancy depends largely on whether material has been collected from surgical or autopsy records.

The reports of the vascular malformations and benign vascular tumors of the stomach collected from the literature for our review include the following: 11 cases of multiple telangiectasia, 3 of capillary hemangioma, 1 case of mixed capillary and cavernous hemangioma, 4 cases of multiple phlebectasia, 1 case of diffuse expansive cavernous hemangioma, 2 cases of multiple diffuse expansive cavernous hemangioma, and 5 of unclassified hemangiomas. This makes a total of 27 benign vascular lesions.

Four benign vascular tumors of the stomach were found in the Mayo Clinic series. They were classified as follows: 1 capillary hemangioma (Fig 2), 1 mixed capillary and cavernous hemangioma, and 2 polypoid cavernous hemangiomas.

*Incidence of malignant vascular tumors.* Malignant lesions derived from the connective tissue



Fig 2. Capillary hemangioma of the stomach, 11 by 3 by 2.5 cm. Note ulceration of the mucosa at the distal end (top) of the tumor.

and supporting structures such as the blood vessels are rarely encountered in the stomach.

Dahlgren in 1934, reviewed the reports of 11 previously described endotheliomas in the literature and added 1 case of his own. He mentioned the following histopathologic classification of these lesions: endothelioma, with no further descriptive terms, 6 cases; lymphangioendothelioma, 3 cases; hemangioendothelioma, 1 case; and perithelioma or capillary hemangioendothelioma, 1 case. In 1 case no microscopic details were given.

Lemon and Broders, in 1942, stated that sarcomas have been estimated variously to comprise from 1 to 8 per cent of all neoplasms of the stomach. They published a review of 14 cases which included leiomyosarcomas, fibrosarcomas and 2 hemangioendotheliomas. They postulated that this low ratio of 2 hemangioendotheliomas seemed reasonable because of the abundance of smooth muscle in the stomach as compared with the amount of vascular endothelial tissue.

Data on the malignant vascular lesions of the stomach which were reported in the literature are summarized in Table II. These lesions included 3 hemangioendotheliomas, 12 endotheliomas, and 8 Kaposi sarcomas. Records of 7 cases of hemangioendothelioma (Fig 3) of the stomach were

found in the Mayo Clinic series. The clinical details are given in Table 3.

**Symptoms.** There are no characteristic digestive symptoms which may be attributed to benign tumors in the stomach. Alfanes and Geschickter stated that in their series of 50 cases, 36 patients gave no indication of the presence of a lesion.

In our collected review of 33 cases of benign vascular tumors of the stomach we found that symptoms developed in 24 cases as follows: vague gastric distress in 2 cases, pain in 2, weight loss in 2, hematemesis in 4, melena in 12, fatigue in 3, vomiting in 1 case and death followed severe gastric hemorrhage in 4 cases.

Bleeding from these hemangiomas may be of two types: the patient may have a severe hemorrhage with hematemesis and melena, or the blood may be lost by minimal persistent oozing, with associated signs of secondary anemia.

The hemangiomas often project into the gastric lumen and tend to develop a pedicle as a result of peristaltic activity. This occurred in 3 of the 4 cases reported in the Mayo Clinic series. Pyloric obstruction from a ball valve action of the tumor may cause pain, nausea, and severe vomiting.

**Symptoms of malignant vascular tumors.** The symptoms produced by the malignant vascular lesions included pain in 8 cases, hematemesis in 5, weight loss and marked weakness in 1, melena in 7 and vomiting in 1 case. A palpable mid epigastric mass was noted in 2 cases.

Patients with malignant vascular lesions of the stomach often give a history of vague epigastric distress for many years followed by a long period without complaints. A return of progressive severe symptoms brings them to a physician for diagnosis. This historical sequence occurred in 4 of the 7 patients in the Mayo Clinic series.

**Differential diagnosis.** The development of the flexible gastroscope and the establishment of more accurate roentgenologic criteria have made the differential diagnosis between benign and malignant lesions more accurate; however all tumors appearing in the stomach must still be considered malignant till proved benign by examination under the microscope. This requires biopsy or complete surgical extirpation.

The gastroscopic appearance of multiple telangiectatic lesions was first described by Remshaw in 1939. Pigmented spots and chronic localized gastric purpuric lesions must be considered in the differential diagnosis.

**Treatment.** The treatment of all vascular malformations and vascular tumors, when possible, should be complete surgical extirpation. When one is confronted with a specific gross vascular

lesion of the stomach, the chances are against that lesion's being or remaining benign and, even though some method for adequate biopsy might be developed, the risk of the complications of ulceration, bleeding, and later malignant change would still outweigh the risk of surgical treatment in all but the most extensive lesions.

The type of resection indicated depends on the position and extensiveness of the lesion and on the operative risk for the individual patient.

Judd and Hoerner in 1936, summarized their indications for removal of benign tumors as follows: (1) small, single, symptomless lesions high on the cardia are inaccessible and local excision may be advantageous; (2) gastrojejunostomy must be considered in all cases of local excision to overcome any tendency toward gastric retention secondary to interference with gastric motility; (3) a Billroth I type of resection may be utilized in lesions near the pylorus; (4) Billroth II and Polya operations are best considered for treatment of large tumors; and (5) multiple lesions require radical resection.

The polypoid tumors of the stomach are all potentially malignant, and with the decrease in mortality following wide and extensive gastric resections during the past decade, together with minimal postoperative gastric symptoms, the risk of possible malignant changes in the pedicle and surrounding tissue far outweigh the risk of radical resection except in the few cases in which a potentially high morbidity or mortality rate prevails with any type of abdominal exploration.

Abdominal exploration and gastric resection is the treatment of choice for all malignant vascular lesions regardless of the histopathologic structure. Many lesions are found to have a sharp line of demarcation from other viscera and, in spite of size, many have been resected with excellent results. A summary of the clinical findings, methods of treatment, and the results is given in Tables I, II, and III.

Local application of radium is impossible in the stomach and radon needles would be a very poor substitute for radical surgical treatment. Roentgen rays may be used in the treatment of very extensive cavernous hemangiomas which involve many intra-abdominal structures and cannot be resected. Several cases of this type are mentioned in the literature but follow-up studies are inadequate.

**Prognosis.** Osler (183) Boston, Watson and McCarthy and Stellar have all cited cases of gastric telangiectasia in which death resulted from hemorrhage; however many patients with this type of lesion continue with intermittent



Fig. 3. Hemangioendothelioma, grade 1 of the stomach, with imperfect formation of sinuses or capillaries. There is moderate variation in the size and shape of fusiform endothelial cells, with elongated nuclei and rare mitotic figures (hematoxylin and eosin  $\times 173$ )

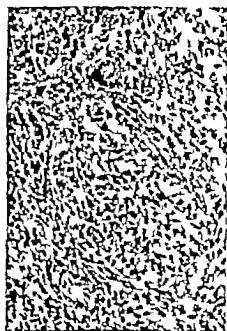


Fig. 4. Hemangioendothelioma, grade 1 of the duodenum. Note moderate anaplasia of fusiform and oval-shaped endothelial cells, arranged in masses around imperfect capillaries or forming papillary projections in larger cavernous spaces (hematoxylin and eosin  $\times 173$ )

gastric hemorrhages throughout life and die of other unrelated conditions.

Many factors influence the prognosis for patients with vascular lesions in the stomach. These include the general surgical risk with regard to the particular patient, the type, extensiveness and metastatic spread of the lesion and the surgical complications associated with and following removal of vascular tumors. A summary of the data in these cases is presented in Tables II and III.

A large majority of the patients with benign lesions had no further symptoms after surgical extirpation of the vascular tumor. Of 7 patients with hemangioendotheliomas of the stomach observed in the Mayo Clinic series, 3 were living and well 20 years after surgical treatment, 2 were living 7 and 4 years respectively, after surgical treatment, 1 patient, with a high grade hemangioendothelioma, died of extensive recurrence from the original lesion 8 years after operation and roentgen therapy and 1 could not be traced.

*Vascular malformations and vascular tumors of the duodenum.* Although benign tumors of the duodenum are extremely rare, their incidence is only slightly lower than that for primary malignant growths occurring in the same segment of the gastrointestinal tract.

Laboulbène, in 1872 reported the death of a patient following severe hemorrhage from an almond-sized duodenal tumor which contained both capillary and cavernous blood-filled spaces. Since

the time of this early case report only 6 other benign vascular tumors have been mentioned in the literature. Five of these were cavernous hemangiomas, while no histopathologic details were presented of the sixth one.

Two simple polypoid cavernous hemangiomas and 8 hemangiomas of the multiple phlebectasia type were found in the duodenum in the Mayo Clinic series. Several polypoid cavernous hemangiomas which prolapsed into the duodenum from the gastric side of the pylorus are not included.

Kaposi's sarcoma involved the duodenum in 4 cases reported in the literature while a record of 1 hemangioendothelioma, grade 1 (Fig. 4) was found in the Mayo Clinic series.

*Symptoms, treatment, and prognosis.* Tumors of the duodenum cause no characteristic symptoms. The important clinical features which bring them to the attention of the physician are obstruction and bleeding. Many lesions are first encountered at the time of roentgenologic examination which is made because of vague gastrointestinal distress.

When a tumor is palpated in the duodenum during a surgical procedure it is important to determine its site of origin in order to avoid an unnecessary duodenostomy or duodenectomy for a prolapsing gastric lesion. Manipulation of the tumor may push it back through the pylorus into the stomach where a gastrotomy or gastrectomy is then possible.

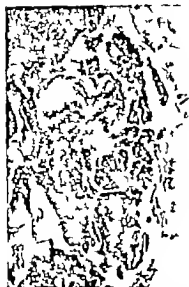


Fig 5. Cavernous hemangioma of the jejunum, multiple phlebotasia type. Note large blood-filled endothelium-lined spaces with connective tissue septa (hematoxylin and eosin  $\times 24$ ).

Polypoid vascular lesions of the duodenum may be removed by local excision and transverse closure of the operative defect, however with moderately extensive tumors and a mobile duodenum, partial duodenectomy and even associated partial gastrectomy may be indicated.

Ackerman, in 1937, performed an autopsy in a case in which there were 2 nodular hemangiomas of the duodenum. These tumors had ruptured into the retroperitoneal space where 400 c.c. of blood had collected.

Reports on 16 benign vascular tumors were found in our review of the literature. Seven of these were ulcerated and produced severe gastrointestinal hemorrhages. One compressed the common bile duct and caused progressive jaundice and hepatic failure. Two produced symptoms of partial duodenal obstruction. Nine lesions produced no known symptoms during life. Three patients were free of symptoms after surgical extirpation of the lesion. Five patients died as the direct result of some complication from the benign vascular tumor.

Data on 5 malignant vascular tumors of the duodenum were collected from the literature and from the records of the Mayo Clinic. Four patients died of complications from a Kaposi sarcoma. One patient was living 4 years after surgical extirpation of a hemangioendothelioma, grade 1.

*Vascular malformations and vascular tumors of the small intestine.* The occurrence of vascular

malformations is closely correlated with the embryologic development of the circulatory system in the small and large intestines. The main branches of the mesenteric arteries which supply the intestines are formed early in the mammalian embryo. The earliest capillaries then develop in a fairly definite plane which corresponds to the future submucosa. From this capillary layer the earliest vessels allegedly sprout and form the rami which nourish the smooth muscle and mucosa of the small intestine. Congenital developmental anomalies of the vascular system are more likely to arise in this active, early developmental layer. The formation of a large part of the small intestine occurs in the later months of fetal life and it is thus reasonable to assume that there is a greater chance that fetal rests remain in this segment of the digestive system. This postulate is substantiated by the observation that more vascular tumors occur in the small intestine than in any other segment of the gastrointestinal tract.

*Incidence.* Gascoven is given credit for reporting in 1860, the first case of hemangioma of the small intestine. Since that time numerous case reports and reviews have mentioned the general incidence of vascular lesions in the small bowel.

Dewes, in 1906, and Helvestine, in 1913, cited the incidence of hemangiomas in the small intestine to be around 1 per cent by comparison with other benign tumors, whereas Geschickter in 1935 and Merchant, in 1939, considered a much higher figure, 10 or 12 per cent, to be more representative.

Reports on 67 benign vascular lesions of the small intestine were found in the literature and 51 similar tumors were examined in our study of the Mayo Clinic series. The total group of 118 tumors of the small intestine represented more than 41 per cent of all benign vascular lesions found in the gastrointestinal tract during this review. A detailed summary of these cases, including the histopathologic features of the tumors, is presented in Tables II and III. A section of a cavernous hemangioma of the jejunum is shown in Figure 5.

The incidence of malignant vascular tumors, when compared with that of malignant lesions found in the small intestine, was given by Mayo as about 1 per cent. In our review 18 malignant vascular tumors were found to involve the small intestine. This group included 6 hemangioendotheliomas, 10 Kaposi sarcomas, and 2 "benign metastasizing hemangiomas."

It may be seen that, contrary to the fact that usually more malignant than benign lesions of a similar histopathologic type involve the small in-



Fig 6 Transillumination of the ileum reveals translucent valvulae conniventes, submucosal vascular plexus and multiple, opaque, cavernous hemangiomas, multiple phlebectasia type.

testine in our study only 18 malignant as opposed to 118 benign vascular tumors were found thus, 87 per cent of the vascular lesions were benign.

**Symptoms.** Mucosal ulceration and bleeding is a frequent complication of all tumors located in the small intestine. There is, however a greater risk of exsanguinating hemorrhages associated with vascular lesions because, like old duodenal ulcers which have inflammatory scar tissue and sclerosed blood vessels at their base the parenchyma of vascular tumors does not have functioning smooth muscle to act as a protective mechanism to close off the large vascular bed from the intestinal lumen. Nineteen per cent of the benign vascular tumors and 20 per cent of the malignant vascular tumors tabulated in this review presented clinical evidence of gastrointestinal bleeding. Four patients died of severe hemorrhage and 4 others died of some complication following operation.

Vascular lesions of the small intestine may produce either partial or complete obstruction by gradual encroachment on the lumen of the bowel or by prolapse and intussusception. The slowly enlarging vascular lesions are associated with vague recurring abdominal pains, distention gurgling and increasing constipation. Nausea and vomiting appear late in the course of the disease.

Benign tumors of the small intestine are often cited as the greatest single etiologic agent responsible for intussusception in adults. Nicoll in 1899 described a double intussusception at the site of a cavernous hemangioma of the small bowel.



Fig 7 Diffuse cavernous hemangioma of the jejunum, ileum, and mesentery.

A review of the data on vascular tumors in the small intestine indicated that pain, nausea, vomiting and perhaps abdominal resistance were the most prominent features in 13 cases, whereas only 4 lesions had actually caused intussusception at the time of operation.

**Differential diagnosis.** Naumann has described chylangiomas of the intestine which have the same histologic structure as hemangiomas. Their endothelial spaces contain a gelatinous pink staining material derived from lymph.

A second differential point, to be considered at the time of operation, is chronic congestion of the portal system which may produce saccular dilatations of subserosal and even submucosal veins. The histologic pattern of these lesions is similar to that of veins and not to that of cavernous hemangiomas. Transmitted light may demonstrate a sacculatation of the vein wall, which is in contrast to what occurs in hemangiomas which have a separate blood supply and a convex surface toward large veins in the vicinity (Figs. 6 and 7).

**Treatment and prognosis.** Complications such as intestinal obstruction, intussusception, and severe hemorrhage may require immediate operative intervention after the circulating blood vol





Fig. 8. Diffuse cavernous hemangioma of the vermiform appendix. The serosa of the cecum was also covered by this vascular lesion (hematoxylin and eosin  $\times 24$ ).



Fig. 9. Diffuse cavernous hemangioma of the cecum and appendix. (From Hunt, V. C. Hemangioma of the large bowel. *Surgery* 1941 50:652)

ume and the chemical balance have been restored to as near normal as practical and after anemia has been corrected. Extraluminal benign vascular tumors may be extirpated without invading the mucous membrane or endangering the blood supply of the associated bowel. Resection of a segment is necessary in some cases because of size, extension, and possible malignancy of the lesion.

Palliative forms of treatment such as cauterization, partial extirpation, roentgen therapy, implantation of radon seeds, and injection of sclerosing solutions should be considered only for lesions that are too extensive for adequate resection.

Of 67 benign vascular lesions of the small intestine cited in the literature, 15 were excised with recovery of the patient, and 5 patients died after operation. Fifty-one similar intestinal lesions in the Mayo Clinic series were evaluated in our study 3 of which were excised with the patients living 5 years after operation, 2 were found too extensive for resection and 46 caused no known symptoms during life.

One hemangioendothelioma in the small intestine was excised and affected nodes were found at operation. The patient died 14 months after the onset of symptoms, of extensive local recurrence and metastasis from the original tumor which was graded 3. Another patient with a hemangioendothelioma, grade 1 was living and well 3 years after operation.

*Vascular malformations and vascular tumors of the appendix.* Dandy in 1914, after a thorough

search of the literature, was able to collect 10 examples of benign tumors of the appendix and presented the first review of this condition. No vascular tumors were found in this group.

Allescher in 1923, described an angiofibroma which occurred in the appendix. The symptoms, not unlike those of acute appendicitis, resulted from torsion of the appendix and the associated lesion. The appendix was 17 cm. long and all portions of the vascular system were reproduced in the contiguous tumor.

Since the time of the first report, 2 other vascular tumors of the appendix have been cited in the literature and 4 cases were found in the Mayo Clinic series (Figs. 8, 9 and 10). A clinical summary of these is presented in Tables II and III.

One of the 3 patients cited in the literature and 1 of the 4 patients mentioned in the Mayo Clinic series had symptoms consistent with those of acute appendicitis. Three vascular lesions were noted during surgical exploration for other conditions, while 2 cases were not reported in detail. The appendix was removed in 5 of the 7 cases. No postoperative complications or subsequent death could be attributed to the presence of these vascular tumors. One patient in the Mayo Clinic series had a hemangioendothelioma, grade 1. He died at home, 2 years after resection of the tumor during a tonsillectomy.

*Vascular malformations and vascular tumors of the colon, rectum and anus* Increasing emphasis has been placed on improvement of diagnostic methods as applied to the study of intestinal dysfunction. The appearance of gastrointestinal bleeding, cramping abdominal pains, or any change in bowel habits is now evaluated not only by the study of stool specimens but by extensive use of the proctoscope, sigmoidoscope, and roentgenoscope. Consequently many of the rare lesions such as the vascular tumors are now more frequently encountered, and further emphasis on reporting these cases in the literature has led to a better understanding of their relative incidence, complications, treatment, and prognosis.

A comparison of numerous reports and various estimates of the general incidence of vascular tumors of the colon shows a marked discrepancy depending on whether surgical material or autopsy specimens are examined. The incidence observed at autopsy also depends on the care taken to note benign lesions, whereas the incidence at operation is higher for those lesions which commonly produce severe symptoms.

Bensaude and his coworkers (26) in 1938 classified 15 cavernous hemangiomas of the rectum, sigmoid, and anus which had been reported in the literature. They arbitrarily separated them into the ano-recto-sigmoidal cases in which involvement of the skin did not occur and the gastro-perineo-rectal types in which involvement of the skin did occur. Eleven lesions were confined to the mucous membrane and 4 caused related involvement of the skin.

Hunt in 1941 stated that there were apparently only 20 cases recorded in the literature in which hemangioma had been encountered in the large bowel at operation or autopsy.

Reports of 61 benign and 9 malignant vascular lesions located in the colon and rectum were found in the literature and summarized in our review. That is, of 234 benign and malignant vascular lesions which were found in the gastrointestinal tract, 70 lesions or 30 per cent, were located in the colon, rectum, and anus.

Thirteen benign and 2 malignant vascular tumors were found in the Mayo Clinic series. Thus, from a total of 110 vascular lesions spread throughout the gastrointestinal tract, 15 lesions, or 14 per cent, were located in the large bowel, rectum, and anus.

Data on the cases of vascular lesions occurring in the colon, rectum, and anus are given in Tables II and III.

**Symptoms.** In patients with vascular lesions of the colon symptoms may develop from either



Fig. 10. Hemangioendothelioma, grade 1, of the vermiform appendix. Note vascular spaces or cavities surrounded by polygonal endothelial cells with oval or fusiform nuclei and with scattered mitotic figures (hematoxylin and eosin  $\times 85$ ).

intestinal obstruction or severe hemorrhage. Cavernous hemangioma must be considered in the differential diagnosis of any rectal bleeding during the first year of life.

The patients in 42 of the 85 cases encountered in our review had either acute or chronic episodes of bleeding into the bowel lumen; therefore since 16 vascular lesions were noted only as incidental findings at autopsy in 42 of 69, or 61 per cent, of the clinical cases some type of intestinal hemorrhage was demonstrable. The serious prognosis for patients with a diffuse expansive cavernous hemangioma of the colon or rectum has been considered in the section on pathology.

Vascular lesions may produce acute or chronic intestinal obstruction as a result of (1) gradual enlargement of the lesion with resulting occlusion of the intestinal lumen, (2) intussusception or (3) volvulus. Obstructive symptoms were observed in 12 of the 69 clinical cases found in this review.

Vascular lesions occurring in and around the rectum may cause urgency, rectal tenesmus, incomplete stool evacuation, and the sensation of prolapse or extrusion of a mass from the anus. A primary cavernous hemangioma in this location may erode through the bowel wall into contiguous structures. Rectovaginal fistulas developed in 2 cases.

**Differential diagnosis.** The criteria for roentgenologic diagnosis of vascular lesions in the colon



Fig. 11. Single polypoid cavernous hemangioma of the rectosigmoid. N is large submucosal blood filled spaces with thrombosis and calcium deposits (hematoxylin and eosin  $\times 40$ ).

are similar to those for other tumefactions occurring in this segment of the intestinal tract. Phleboliths or calcareous concretions may form in the cavernous spaces of a hemangioma and have been observed in a few cases during roentgenologic examination. Digital examination reveals the nodular character of rectal lesions and, on direct proctoscopic observation, they appear bluish in color from the blood which may be aspirated from the vascular sinuses.

**Treatment.** The treatment of these lesions depends, as in other types of benign and malignant tumors, on their location, degree of extension, and their association with other intraperitoneal structures.

The capillary hemangioma, mixed capillary and cavernous hemangioma, and the simple polypoid cavernous hemangioma may be removed by transcolonic excision; however the benignancy of large lesions may be questionable and, in this event, radical resection of the contiguous segment of colon and associated mesenteric nodes carries a better prognosis.

Multiple cavernous hemangiomas of the phlesectasia type seldom produce symptoms and, unless a definite source of bleeding is noted at the time of operation, any type of resection is associated with a higher mortality rate than is conservative management.

The single and multiple diffuse cavernous hemangiomas (Figs. 11, 12 and 13) present the most serious complications of all benign vascular



Fig. 12.

Fig. 12. Extensive diffuse cavernous hemangioma of the sigmoid and rectum. A second cavernous hemangioma was found in the pelvis of the right kidney.

Fig. 13. Multiple, diffuse, cavernous hemangiomas of the arm, scrotum, and penis. A single, ulcerated, polypoid, cavernous hemangioma was removed from the sigmoid.

tumors and are extremely difficult to treat. Many of these lesions are very extensive and involve other intra-abdominal structures, a fact which, with radical resection, leads to a prohibitive surgical mortality rate. Ligation and injection of the vascular bed supplying a large cavernous hemangioma has a very limited field of application, not only because of the danger from intestinal necrosis or severe hemorrhage, but also because few hemangiomas, unless very small, have disappeared after a single injection of sclerosing solution. Operations which sidetrack the lesion have been undertaken but these procedures alone leave a potential source of hemorrhage. Colostomy followed by high voltage roentgen therapy, has been successful in a few cases. Resection of the scarred and stenosed colon together with the remaining partially sclerosed tumor may then be considered.

Many of the diffuse cavernous hemangiomas of the rectum and sigmoid colon are so extensive that combined abdominoperineal resection or posterior



Fig. 14. Hemangioendothelioma of the rectum, grade 1 with spindle-shaped and oval-shaped endothelial cells in-losing imperfect capillaries. Rare giant cells and mitotic gures are visible (hematoxylin and eosin  $\times 173$ )



Fig. 15. Hemangioendothelioma, grade 3 of the rectum. Atypical endothelial cells with numerous mitotic figures and pleomorphic giant cells are visible (hematoxylin and eosin  $\times 173$ )

resection seems impractical; however, the prognosis for the patient has been so serious that extensive resection should be carefully considered.

The hemangioendotheliomas (Figs. 14 and 15) should be widely excised and high voltage roentgen therapy or local application of radium should be used in the postoperative period.

#### SUMMARY

This study included a review of the available literature on the subject of vascular malformations and vascular tumors which involve the gastrointestinal tract. Because of the extreme infrequency with which these cases occur it seemed desirable that every report encountered in the literature be summarized to amplify our knowledge of this subject. Data on 189 cases of benign vascular lesions and 45 cases of malignant vascular lesions were collected from the literature.

The clinical histories and pathologic specimens on 94 cases of benign vascular lesions and 16 cases of malignant vascular lesions of the gastrointestinal tract, found at operation or autopsy at the Mayo Clinic, were also available for study.

The histogenesis of vascular lesions is frequently obscure, therefore, a more practical method of classification has been presented, which is derived from a study of the histopathologic structure of the lesions.

A review of studies on the experimental production of metastasis, and transplantation of hemangioendothelioma in white mice has been presented.

The symptoms, diagnosis, and treatment of vascular lesions depend on the specific anatomic segment of the gastrointestinal tract which is involved as well as on the histopathologic structure of the lesion; therefore, a study of each separate unit of the digestive tract has been included in this review.

#### CONCLUSIONS

1. Vascular malformations and vascular tumors are among the rarest lesions found in the gastrointestinal tract. It has been roughly estimated from this study that they occur once in approximately 14,000 patients.

2. The histogenesis of vascular tumors of the gastrointestinal tract is obscure; however, a consideration of their histopathology can be of assistance in determining adequate methods of treatment and prognosis.

3. Hemangiomas are rarely of one pure type. Classification of them depends primarily on grouping together different lesions which have the same cellular arrangement.

4. The criteria for an absolute diagnosis of gastrointestinal telangiectasia, as with other vascular lesions, should be limited to those based on histopathologic study.

5. Although in some of the reported cases of gastrointestinal telangiectasia death followed a severe hemorrhage (14 per cent), radical extirpation of these lesions is impractical because of their multiplicity and their tendency toward spon-

taneous regression. Repeated injections of moccasin venom or the administration of rutin may decrease the tendency to bleed.

6. A large majority of the patients with a capillary hemangioma of the gastrointestinal tract experienced symptoms during life (89 per cent) surgical extirpation was undertaken in many (78 per cent) and only a few died as a direct result of their lesion (11 per cent)

7. The mixed capillary and cavernous type of hemangioma may be a transition stage between the two major developmental groups or it may result from evolutionary changes which appear in every hemangioma with growth and aging

8. The cavernous hemangioma of the multiple phlebectasia type is more commonly observed, both at operation and autopsy than is any other vascular lesion found in the gastrointestinal tract.

9. The polypoid vascular tumors tend to cause intussusception and obstruction, whereas the sessile lesions are more likely to develop surface ulceration and produce gastrointestinal hemorrhage.

10. The majority of small benign vascular lesions of the gastrointestinal tract are associated with the submucosal capillary plexus, whereas the diffuse expansive cavernous hemangioma involves large arteries and veins.

11. The diffuse cavernous hemangioma tends to expand over the surface of adjacent structures in the peritoneal cavity not associated with the gastrointestinal tract; however, unless the normal vascular segment which supplies these other organs or tissues demonstrates cavernous changes there will be no communication between the tumor and the blood supply of the contiguous normal structure.

12. When multiple and often mobile deposits of calcium are seen on roentgenographic examination, the diagnosis of a vascular tumor should be considered.

13. More than two-thirds of the benign vascular tumors of the gastrointestinal tract were found in males, whereas the malignant vascular tumors were about equally divided between the sexes.

14. The evidence indicates that a majority of all benign vascular tumors (66 per cent) and all malignant vascular tumors of the gastrointestinal tract produce symptoms during the patient's life.

15. The hemangioendothelioma is more frequently observed than any other type of malignant vascular lesion found in the gastrointestinal tract.

16. Many of the hemangioendotheliomas appear in young adults who may give a history of relatively long duration of symptoms. The prognosis is excellent for those patients with low

grade lesions which are surgically excised and followed by extensive radiation therapy. The higher grade lesions metastasize early to both local and distant parts of the body through the lymphatic channels or blood stream, and the patients are rarely cured after removal of the primary growth, even when removal is followed by extensive radiation therapy.

17. Many benign and malignant vascular tumors of the gastrointestinal tract encountered in our review of the literature and in the Mayo Clinic series were surgically excised and the patients had no further symptoms (30 per cent).

18. Unless more patients who have gastrointestinal bleeding of indeterminate origin, symptoms and signs of intestinal obstruction, or a freely movable abdominal mass are given the benefit of abdominal exploration, 1 of 9 patients with a benign vascular tumor and 1 of 2 patients with a malignant vascular tumor will die according to the data obtained in our investigation.

19. The small intramural or sessile vascular tumors of the esophagus rarely produce symptoms; however those which cause obstruction or hemorrhage have, thus far been incompatible with life.

20. Vascular malformations and vascular tumors of the stomach are rarely encountered; however their importance is emphasized by a high incidence of severe complications, the frequent occurrence of malignant change, and the satisfactory prognosis after their adequate surgical removal.

21. Contrary to the belief that usually more malignant tumors than benign tumors are found in the small intestine, we found that 82 per cent of the vascular tumors were benign.

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# ABSTRACTS OF CURRENT LITERATURE

## SURGERY OF THE HEAD AND NECK

### EYE

Visual Protection to Aerial Warfare. P. C. LIVINGSTON. *Brit J Ophth*, 1948, 32: 660.

The introduction of equipment aimed at preserving vision of aircrew personnel requires maintenance of morale, that they not become eye conscious, and that they use the equipment on operational duty. The low number of eye injuries sustained by the Royal Air Force in flying operations indicates the value of a planned campaign against ocular injuries.

The preservation of sight can be aided by the use of bullet proof glass screens and armor plates, whose use is restricted by weight. Further protection can be effected by the use of safety glass in flying goggles, which can also be ground to correct refractive errors. Contact lenses are of limited use because of intolerance due to ocular sensitivity. An indirect method of protection was visual training to quicken the powers of recognition of aircraft and improving rod vision under conditions of low illumination.

FRANK W. NEWELL, M.D.

Histological Findings in a Case of Angioid Streaks. F. H. VICKROY. *Brit J Ophth*, 1948, 32: 531.

The author discusses angioid streaks of the retina. Ophthalmoscopically this basophilic condition (calcification) brightens the contiguous fundus and renders more conspicuous the dark red choriocapillaris exposed by the ruptures in Bruch's membrane (producing streaks). Proliferative changes which may occur along or within the streaks may alter their appearance.

Ruptures which occur in senile eyes do not widen into visible streaks probably because the senile choroid loses its elasticity before Bruch's membrane becomes calcified.

Other lesions of the macula in cases of angioid streaks are due to proliferative changes affecting the pigment epithelium (senile degenerative changes). The subretinal hemorrhages in the macula and elsewhere are ascribed to fractures of the calcified membrane causing ruptures of the choriocapillaris. If such a hemorrhage elevates the pigment epithelium in the macula, "disciform degeneration" results.

Hemorrhages within the retina, as well as circinate retinitis are attributed to the vascular changes that commonly occur in cases of angioid streaks.

It is difficult to explain the presence of angioid streaks in association with some cases of pseudonanthoma elastikum, with Paget's disease, with cardiovascular disease, and in some cases as an isolated phenomenon. The associated conditions may be dependent upon heredity.

According to histologic examination angioid streaks represent ruptures of Bruch's membrane. The gaps are widened by the elastic tension of the choroid. JOSHUA ZUCKERMAN, M.D.

Participation of the Ocular Appendages in Sympathetic Ophthalmia and Its Bearing on Enucleation. BERNARD SAMUELS. *Brit J Ophth*, 1948, 32: 560.

The author divides his paper into several sections. The first section has to do with the nature of sympathetic ophthalmia. In it he declares that this condition is in the nature of an infiltration and selective affinity for uveal tissue, but a characteristic feature of the condition is the tendency of spread outward beyond the globe.

The next section has to do with the pathways of the virus, namely, (1) along the uveal tract, (2) through the globe into tissues of the orbits, and (3) into the optic nerve. Histologic sections show the infiltration process in the orbit outside of the globe and in and around the optic nerve. The nerve sheaths are involved only in far advanced cases.

In the last section the author concludes that when the existing eye is enucleated as a preventive measure before signs of inflammation are seen in the second eye, an ordinary, simple enucleation is sufficient. However if signs of inflammation appear in the second eye the enucleation of the existing eye should include removal of the inferior oblique muscle, the optic nerve as far as possible, the retrobulbar tissues almost to the apex of the muscle cone, and the globe itself. The wound should be left open to drain.

EARL H. MEER, M.D.

Radiotherapy of Malignant Intraocular Neoplasms. H. B. STALLARD. *Brit J Ophth*, 1948, 32: 62.

Radiotherapy is excellent for retinal glioma, but the treatment of malignant melanomas by radon seed is not satisfactory. Metastatic carcinomas of the eye requires treatment of sufficient strength to destroy it and yet not destroy the eye. This is difficult and the object of this work.

The treatment is done with plaques of platinum or silver 0.5 mm. thick containing radium salt, curved to fit the sclera over the site of the neoplasm, and fixed by sutures through the episclera at this point. The advantage is a more even and accurate distribution of irradiation to the neoplasm. Illustrations are shown.

The dose given is the maximum dose that the eye tissues will stand without serious destructive changes. A dose of 3,500 roentgens seems quite effective.

The results are good when the neoplasm occupies one quadrant of the globe or less.

The complications commonly encountered are (1) cataract (2) retinal detachment, (3) intraocular hemorrhage, and (4) shrinkage of the globe.

EARL H. MERR, M.D.

**Goniotomy for the Relief of Congenital Glaucoma.**  
OTTO BARKAN *Brit J Ophth* 1948, 32 701

Goniotomy is an operation for stripping or peeling embryonic tissue from the angle wall. The author has used the technique in 76 eyes with congenital glaucoma and in 66 of these the pressure was normalized and vision was maintained or restored.

The early symptoms of congenital glaucoma are due to an increase in intraocular pressure and consist of corneal cloudiness, hyperemia of the bulbar conjunctiva, photophobia, epiphora, and blepharospasm. The onset of symptoms is usually before the fourth month and in some cases may occur with extreme suddenness.

The ocular hypertension causes corneal cloudiness which in the early stages is completely reversible by surgery or with drugs. Persistence of the cloudiness causes a milky opacification and irregular astigmatism which prevents the development of central vision. Optic atrophy occurs only after the intraocular pressure has been elevated for a long period.

The angle in congenital glaucoma shows the iris to be inserted anterior to its normal position by means of adventitious mesodermal tissue. The area of transition from the anterior surface of the iris to the posterior surface of the cornea consists of gelatinous looking semitransparent substance. In eyes successfully operated upon the embryonic tissue was stripped from the angle through one fourth to one third of its circumference.

The operation is indicated in all cases of congenital glaucoma in which the increased pressure is the result of obstruction of the angle by persistent embryonic tissue. In general, the earlier the operation is done after the onset of symptoms the more effective it is in restoring vision. Goniotomy is contraindicated in eyes in the advanced stage with scarring and a corneal diameter of more than 15 mm.

The operation is performed under ether-oxygen anesthesia. The initial success is enhanced if a contact lens is used with marked cloudiness of the cornea. Preliminary abrasion of the corneal epithelium permits its use. An assistant maintains fixation and with the contact lens in position the anterior chamber is entered with a goniotomy knife 1 mm anterior to the limbus in the superior inferior temporal quadrant. The knife crosses the pupil and its blade is inserted anterior to the root of the iris, and then rotated counter clockwise in this plane as long as visibility permits. The knife is then removed and a few seconds later a slight venous oozing occurs which is absorbed in a few hours. Eserine ointment and binocular pads are applied.

Complications include failure to strip the angle, iridodialysis and hemorrhage. Early diagnosis and prompt surgery are essential for good results.

FRANK W. NEWELL, M.D.

## EAR

**Reconstruction of the External Ear.** HERBERT CONWAY CHARLES G. NEUMANN, JEROME GELB, LEO L. LEVENDORF, and JULIUS M. JOSEPH. *Ann. Surg.* 1948 128 216.

Reconstruction of the external ear for the correction of substance lost by reason of congenital post infectious or posttraumatic defects, or following the excision of a malignant tumor represents one of the most difficult problems in plastic surgery. An abnormal ear is conspicuous and an absent one is a major cephalic deformity. Criteria for successful reconstruction have been set down by Snraci who lists seven points as essentials if the reconstruction is to be acceptable to the patient and to the surgeon. These are: correct size, similarity of outline, similarity of height, correct cephaloauricular angle, permanency of size and shape, rigidity, and matching color.

The general principles of the technique of Pierce who reported 4 cases in which he used fine cartilage as an inlay graft combined with a cervical tubed pedicle to construct the helix, have been followed with agreement in execution with the advancements of Brown and others. In several cases subtotal reconstruction of the ear has been carried out in two stages. The management of cases included in this report has led to the opinion that suitable reconstruction of the external ear can be accomplished if sufficient attention is given to the cutting and the carving of costal cartilage to the importance of the establishment of a lateral concavity to represent a concha and to the many minor details which enter into the execution of this type of reconstructive surgery.

Experience in the handling of fresh costal cartilage has led to observations which have contributed to success in obtaining a suitable restoration of the external ear. A common objection to the use of straight grafts of cartilage in reconstructive surgery is that after transplantation the graft may undergo distortion of shape, curling. The use of a gouge causes compression of medullary and cortical cells of the costal cartilage in such a way that even after carving, the graft tends to warp or curl. The use of two scalpels prevents abnormal compression of cells and minimizes this tendency. In order to obtain a large graft two adjacent rib cartilages are resected en bloc. The excision of a disc, 2 to 3 mm in thickness at the level of each transection makes easier the removal of such a block of cartilage. Inspection of such a graft from its posterior aspect shows that there is a concavity in the cartilaginous portion of the thoracic cage. This can be used effectively in the carving of cartilage for reconstruction of the ear. As the rib cartilage is split longitudinally advantage is taken of the curling effect to exaggerate this concavity. Cartilaginous or fibromuscular fusion of two adjacent cartilages is made use of in obtaining the desired width of graft. With attention to these details it is possible to cut and carve from costochondral cartilage a free graft which has size, shape and rigidity suitable for reconstruction of the external ear.

Ten cases are reported in which partial or complete reconstruction of the external ear has been carried out. Reconstructions have been effected by the use of buried free grafts of cartilage, their elevation from the head and their backing by free grafts of skin at a second operation. A small tubed pedicle has been used to effect the appearance of the helix in some cases. Technical details in the cutting and carving of costal cartilages have been set down.

The opinion is advanced that reconstruction of the external ear acceptable to both patient and surgeon can be effected if attention is given to these details.

JOHN F. DILLON, M.D.

**Problems of Diagnosis in Obstruction of the Eustachian Tube.** FREDERICK T. HILL. *A. A. Otol. Rhinol.* 943, 57 343

The author believes there are four main causes of obstruction of the eustachian tube: (1) nasopharyngeal lymphoid hyperplasia, (2) acute upper respiratory infection, (3) malocclusion of the bite with resulting compression of the tube, and (4) the possibility of a nasopharyngeal tumor.

Three cases of tumors and one case of a luteal lesion of the torus tubaris, which led to obstruction of the eustachian tube, are reported.

JOHN J. BALLENGER, M.D.

**Clinical Record—Gradenigo's Syndrome, with Report of 2 Cases.** S. HOSOWITZ. *J. Laryngol.* 1943, 63 639.

The author discusses Gradenigo's syndrome—its incidence, clinical manifestations, x-ray appearance, etiology, pathology and treatment.

The syndrome usually occurs during childhood and adolescence, although no age group is exempt and the majority of cases are in males. The right ear is slightly more affected than the left.

The syndrome is characterized by three outstanding symptoms: (1) suppuration of the middle ear, (2) intense pain, usually intermittent over one or more branches of the fifth cranial nerve, and (3) loss of function of the external rectus muscle. In most cases the pain is intermittent, rather severe, worse at night, and occurs mainly over the temporoparietal region although commonly in back of the eye. The distribution varies, and the fibers of the gasserian ganglion mainly are affected. Anesthesia of the cornea may occur. Some patients may complain of pain on motion of the eye. The most outstanding symptom is paresis or paralysis of the sixth cranial nerve usually on the side affected but occasionally on the contralateral side or more rarely on both sides. The third, fourth, seventh, or eighth nerves have occasionally been involved. Paralysis of the abducens nerve leads to symptoms of diplopia. It is observed in the late stages of mastoiditis and is uncommon in the early stages. The average time is from 10 to 40 days after the onset of the ear infection.

If appropriate treatment is carried out, normal function is restored in from 2 to 4 months, but occasionally it takes as long as 6 months. Frequently

nystagmus may accompany the paralysis and occasionally the patient complains of photophobia. The temperature may be normal, but more often it is between 100 and 102 degrees, and in some cases as high as 103 or 105 degrees.

The x-ray appearance is indicative of the condition of the mastoid and the petrous apex. Positive findings are helpful but negative findings do not exclude a pathologic process.

The disease begins in the middle ear and the infection passes to the petrous apex by the continuity of cells, or by direct bone extension. The sixth nerve is affected in the apex of the pyramid when the dura is swollen from the infection with resulting pressure on the nerve. The disease may also be complicated by a localized meningitis and extradural brain abscess, or by an extension of thrombosis from the lateral sinus up to the inferior petrosal sinus. Petrous invasion is more common in the pneumatized temporal bones because the infection can more readily enter the petrous apex by advancing along this cellular structure. There are two main routes of cells extending to the petrous tip—the "antrum-epitympanic" route and the "hypotympanic" route. The organisms involved in the process are usually the pneumococci and streptococci but almost any organism can cause the disease.

The prognosis of the disease depends upon the treatment that is given, the accessibility of drainage and the duration of the disease. The mortality varies from a per cent to as high as 50 per cent, but with the use of sulfonamides and antibiotics, it is hoped that the prognosis may improve.

With regard to treatment, the author states that on rare occasions cure may take place spontaneously but at times the syndrome may terminate in generalized meningitis and death. Surgical intervention with operation on the mastoid is usually required in order to obtain favorable results, occasionally myringotomy suffices. About 80 per cent of patients will recover after simple mastoidectomy but radical mastoidectomy and even petrosectomy is necessary at times. The use of sulfonamides and antibiotics will assist further in effecting a favorable outcome.

The author presents reports of a case of Gradenigo's syndrome. One case was that of a child, aged 14, with acute mastoiditis and lateral sinus thrombosis. This child also developed an otitic hydrocephalus. The second case was that of a 30 year old woman who developed Gradenigo's syndrome in the typical manner from a highly pneumatized mastoid and petrous bone. Following radical mastoidectomy supplemented by antibiotic therapy both patients made a complete recovery.

WILLIAM A. ARBROOK, M.D.

**The Functions of the Round Window.** ERNEST GLEY, WYVER and MERLE LAWRENCE. *Ann. Otol. Rhinol.* 943, 57 379.

The authors present a study of function of the round window. Immobilization was accomplished in various ways while the electrical potentials of the

cochlea were recorded in order to evaluate claims of improved hearing resulting from surgical treatment by the use of round window grafts.

Fourteen cat ears with a ventromedial approach to the auditory bulla were used in the experiments. The cochlear potentials were recorded by an electrode placed on the round window membrane and this system was calibrated with the amplifying system to show the magnitude of the response in absolute units. The authors procedure was to measure the response of the ear to a series of tones under standard conditions with (1) the round window free (2) the round window blocked by one of several agents and (3) with the block removed. The results from blocking were expressed as differences in decibels. The experiments were divided into 4 series.

**Series 1** Immobilization of the round window membrane was accomplished by manual application of a nonconducting thin-shanked lucite probe in contact with the central half of the membrane's surface and producing a noticeable indentation. Not the slightest effect was seen upon the response of the ear to a continuing sound.

**Series 2** Occlusion of the round window by an air tight pressure tube with the other end open to the air reduced the response to high tones slightly as measured in 3 cats. The reduction in response began around 500 cycles and increased regularly as the frequency rose to a maximum loss of around 10 decibels at 10,000 cycles.

With the tube held in the same position and an introduction of air pressure up to 25 mm of mercury the reduction in response noted was similar to that caused by the simple application of the tube.

**Series 3** The third method of immobilization was by a bone wax pack pressed in place by a mechanically held lucite obturator. The authors believed that the responses suffered a small general impairment varying with frequency from 1 or 2 decibels at lower frequencies to 4 or 5 decibels at higher frequencies.

To test the possibility that the tube or obturator was interfering with the sound field, the lucite obturator was placed in its usual position without actual contact and no response was observed.

**Series 4** In this experiment the lateral wall of the tympanic cavity with the drum and ossicles was removed and the sound tube with acoustic probe was sealed over the oval window so stimuli could be delivered directly to this site. After blocking the round window with wax there was little change in response to high tones but in some ears there was a reduced response to low tones although the exact amount in decibels was not stated by the authors.

From these experiments the authors formulate the following conclusions as to the nature of the mechanical change resulting from blocking the round window.

In the presence of the middle ear loading the round window adds mass to the responsive system whereas, in the absence of the middle ear the same treatment of the round window adds stiffness to the

responsive system. Furthermore the authors suppose that the middle ear contributes greatly to the stiffness of the cochlear system and less significantly to its mass this supposition being consistent with a previous study showing that removal of the middle ear affects most seriously the high tones.

In conclusion the authors state that there is no warrant for the use of an immobilizing procedure in clinical practice since the introduction of grafts into the round window can be of no benefit to hearing.

EUGENE L. DERLACKI, M.D.

#### Electrocoagulation of the Membranous Labyrinth Experimental Histological Studies in the Monkey LEROY A. SCHALL and J. H. TOM RAMBO *Ann Otol Rhinol* 1948, 57: 590.

The authors report their conclusions from histological studies of 7 ears in 5 monkeys operated on according to Day's procedure of coagulating the membranous labyrinth through a trephine opening in the lateral semicircular canal.

The stated purpose of the experimental studies was to demonstrate the histological changes occurring as a result of coagulation of the membranous labyrinth and to determine if possible, any variation of technique which might improve the prognosis for hearing.

Two of the ears were not included in the reported findings because of postoperative labyrinthitis caused by unintentional surgical accidents providing an avenue of infection.

The remaining 5 ears were classified according to the amount of current used and the postoperative date of sacrifice, as follows:

	Dial setting	No. Post-operative days
1	20	10
2	20	30
3	20	40
4	20	30
5	30	30

In the 4 ears in which the coagulating current with a dial setting of 20 or more was applied the membranous labyrinth was completely destroyed and the healing of the labyrinth occurred by fibrosis with progressive changes to bone formation. In the ear with the current reduced to a dial setting of 10 the only finding was incomplete destruction of the utricle and saccule. Thus the authors felt with the use of optimum current, complete and predictable damage to the membranous labyrinth results, and elimination of vertigo in Meniere's disease could be expected as a uniform result.

On the other hand the essayists found that there was no predictable correlation in the amount of damage to the cochlea resulting from a variation either in the amount of coagulating current used or the time elapsed since the operation. In 1 ear there was no damage to the cochlea. In the remaining 4 ears the damage varied from localized injury to the organ of Corti and the spiral ligament immediately adjacent to the vestibule (in 1 case) to varying degrees of exudate in the lymphatic spaces and atro-

phy of the functional elements. With the unpredictable cochlear damage, the authors believed that retention of serviceable hearing following operation by Day's procedure was improbable.

EUGENE L. DERLACKI, M.D.

**The Radical Mastoid Operation.** A. ANDERSON. *J. Laryngol.* 1948, 6, 358.

The author presents a preoperative and postoperative audiometric statistical survey of hearing loss in chronic otitis media. The study is based on 535 ears examined clinically and audiometrically in the course of ear consultations for a Medical Board. The stated purpose of this presentation is to demonstrate in a statistical survey that the otologist may venture an opinion by otoscopy alone of the hearing loss in decibels within an insignificant limit of error in cases of chronic otitis media, without any interrogation or testing of the patient, or knowledge of the past history.

The statistical survey is an analysis of the hearing in 478 ears with chronic otitis media under the following headings: (1) 55 ears with a radical mastoid cavity; (2) 31 ears with a cortical (simple) mastoid operation; (3) 133 ears with chronic otitis media with granulations and/or cholesteatoma; (4) 38 ears with aural polyps; (5) 30 ears with attic disease; (6) 14 ears with subacute otitis media; (7) 103 ears with active or healed otitis media, with a residual permanent perforation of the tympanic membrane; and (8) 66 dry ears with the tympanic membrane healed.

All of these ears were tested by the audiometer whispered and conversational voice, and the audiometer.

The hearing of patients in each of these classifications was shown in composite audiographs, apparently an average of all the ears in each group.

Group 1: Thirty-seven ears, those with a radical mastoid cavity averaged in the composite audiograph. Apparently those cases which have been classified as demonstrating a complete loss of hearing are averaged at a 90 decibel loss. The audiograph showed loss averages of 50 to 60 decibels for frequencies up to 2048 and 60 to 80 decibels for the higher frequencies.

Group 2: Twenty-one ears on which a cortical mastoid operation had been performed. In this grouping in which hearing in the other ear was normal, the average impairment is 15 decibels for frequencies up to 4096, and 25 to 45 decibels for the higher frequencies. Where the other ear showed permanent defective hearing and the tympanic membrane on the operated ear showed an attic scar the hearing loss was 40 to 50 decibels for frequencies up to 2048 and 50 to 70 decibels for higher frequencies.

Group 3: One hundred and fifty-three cases of chronic otitis media with granulations and/or cholesteatoma. The average hearing loss is 40 to 45 decibels for frequencies up to 2048 and 50 to 60 decibels for the higher frequencies.

Group 4: Thirty-eight ears with aural polyps showed an average loss of 50 to 55 decibels for fre-

quencies up to 2048 and 60 to 80 decibels for the higher frequencies.

Group 5: Thirty ears with disease confined to the attic region. The composite audiograph shows a uniform loss of hearing of 25 to 30 decibels up to 2048 above which it varies from 25 to 65 decibels in increasing progression.

Group 6: Fourteen ears with subacute otitis media. The hearing loss averaged 20 to 25 decibels up to 2048 and 30 to 35 decibels for the higher frequencies.

Group 7: One hundred and two ears with active or healed otitis media with a residual permanent perforation of the tympanic membrane. The average loss was 25 to 30 decibels for frequencies up to 2048 and progressively from 30 to 50 decibels in the higher frequencies. This entire group was divided in several ways according to size of perforation and presence of moisture. Conclusions were that the ear which is discharging has a greater hearing loss, not usually exceeding 5 decibels, than when the ear is dry and the hearing loss is more marked for the large central perforation by an average 5 to 10 decibels.

Group 8: Sixty-six ears with healed tympanic membrane. The average loss was 20 decibels for the frequencies up to 2048, and 30 to 50 above this.

In addition, the author presents a composite audiograph of 44 ears with otitis externa. The hearing is almost within normal limits except for a high tone loss attributed to secretions in the ear.

EUGENE L. DERLACKI, M.D.

## NOSE AND SINUSES

**Tumors of the Nose and Sinuses.** LE ROY A. SCHALL. *J. Am. Med. Ass.* 1948, 37, 73.

During the past 16 years from 1930 to 1945 inclusive, a total of 219 patients with malignant disease of either the nose or the nasal accessory sinuses, or of both, were seen at the Massachusetts Eye and Ear Infirmary, Boston.

A recent survey reveals that among these 219 patients there were 139 males and 80 females. Their average age was 56 years, the youngest patient being 16 and the oldest 83 years of age. Ten of these 219 cases were untraced and 68 (30 per cent) showed a 5 year or longer survival.

The relation of the treatment to the survival rate may be summarized as follows:

Primarily surgical treatment. 5 year survival in 133  
Primarily radiation treatment. 5 year survival in 73  
Primarily radium therapy. 5 year survival in 10

The successful treatment of cancer of the nose and nasal accessory sinuses, as of cancer elsewhere depends largely upon early diagnosis, prompt and thorough treatment, and treatment that is neither too little nor too late.

The symptoms which may lead one to suspect cancer of this area are few in number and can easily be listed: (1) hemorrhage, (2) nasal obstruction, (3) referred pain to the teeth, (4) painless swelling, (5) paresthesia or anesthesia of the cheek, and (6) exophthalmos.

When a new growth is limited to the nasal cavity nasal obstruction and hemorrhage are the most frequent symptoms. A small growth of the anaplastic type with thin walled blood vessels may show early ulceration with subsequent hemorrhage as its first symptom. With the increase in size of the growth, nasal obstruction occurs. This obstruction is usually unilateral hence it is an axiom that any unilateral obstruction by a growth should be considered malignant until the microscope proves it otherwise. When the tumor is of the slowly growing variety with well developed connective tissue and thick walled blood vessels, hemorrhage may not occur and the only early symptom is that of nasal obstruction. The growth may have the appearance of a simple nasal polyp yet on its removal the hemorrhage may be excessive and this is suggestive of cancer.

The study shows that patients treated primarily by surgery, supplemented by external radiation, or radiation by means of radium in the operative cavity have a better than a 2 to 1 chance of a 5 year survival than those treated primarily by radiation.

JOHN F. DELPH, M.D.

### MOUTH

Recurrent Epithelioma of Lip PERCIVAL P. COLE  
*Brit J Surg* 1948, 36, 79.

The author reports the case of a stoker aged 28, who was referred as a prisoner of war from the Royal Herbert Hospital. In 1939, he had cut the right side of his lower lip while shaving and an ulcer formed which did not heal. The man was treated with radium irradiation in Belfast.

In October 1941, two years after treatment, a recurrence was noted and in March 1942 he was admitted to the Royal Herbert Hospital. A biopsy taken there showed the growth to be an epithelioma. Wassermann and Kahn reactions were negative.

At this time the author observed a deep ulcer with raised edges, measuring 1 cm. by 1.5 cm., extending just to the mucocutaneous junction and involving the lower lip and a corresponding area of the angle of the mouth. There was considerable surrounding induration but no fixation to bone. The right submaxillary gland was enlarged.

The adopted method of reconstruction makes impracticable the approach to the anterior triangle by the usual incisions. The somewhat irregular line tracing the incision along the lower border of the jaw at the base of the anterior triangle divides the area of operation into two parts. In the lower part is the anterior triangle with apex downwards. Free access to its contents is obtained by the reflection of skin flaps posteriorly and anteriorly from an incision joining its apex below to a point roughly midway along its base above.

Operation was performed on May 2, 1942. Gas and oxygen were administered by intubation. The lower area was isolated from the face and mouth and a block dissection undertaken.

Adequate exposure was obtained without removal of the sternomastoid and the jugular vein so that, in this particular case the technique of Butlin was employed in preference to that of Crile. After clearance of the area the skin flaps were united by suture with dependent drainage at the lower angle of the wound. Following isolation of the area thus dealt with the malignant ulcer with a wide margin of surrounding tissue comprising the whole thickness of lip and adjoining cheek, was excised.

It is essential for success in this direction that the mucous membrane be defined and sufficiently freed to be dealt with as a separate layer. Incision of this layer upward and forward increases the length of the lower border of the mucosal flap and so permits it to reach to the midline, if necessary there to secure mucosal closure by suture to the corresponding layer of lip or to a corresponding flap from the other side if the whole lip has been removed.

This method of treatment, first reported in *Lancet*, 1920, 2, 845 has been adopted as the standard technique for reconstruction of the lower lip. It is believed to be the best method for cases in which the lesion involves the angle of the mouth and encroaches upon the cheek to a limited extent. For obvious reasons direct borrowing should be preferred to remote transfer of tissue in such cases but the choice can only be made after a careful survey of conditions present in the individual case.

In conclusion the author states that epithelioma of the lip is encountered most frequently after the age of 50 years. Its occurrence at the unusually early age of 28 in the author's experience was associated with a breach of surface occasioned by a wound or burn. War wounds by bullet or shrapnel have been responsible factors in several such cases, and it is noteworthy that malignancy supervened a very short time after their infliction. The same rapidity of onset is demonstrated in the present case.

Whatever the view that may be taken of the mode of treatment to be adopted for a primary lesion the author believes that recurrence after irradiation computed to be adequate is unquestionably an indication for surgical intervention. In this connection the surgeon would do well to remember the pernicious behavior of tissues in which permanent obliterated vascular changes have resulted from irradiation. In order to secure normal behavior and to eliminate as a preliminary to success a factor whose effect cannot be assessed or compensated for, it is advisable to remove the whole area subjected to irradiation as was possible in the present case.

The possibility of failure and the resulting compulsory resort to surgery constitutes a strong argument in favor of methods which secure intensive localized irradiation in preference to those which employ irradiation on a more diffuse scale. It is indeed a question whether initially the surgical approach should not be preferred to the radiotherapeutic approach. The article is accompanied by 5 figures and 4 photographs.

JOHN F. DELPH, M.D.



## NECK

**Trial Classification of Malignant Thyroid Tumors**  
(Essai de classification des tumeurs thyroïdiennes malignes) JOSEPH F. MARTIN, M. DABONNET and P. GOUTIER. *Ann. Path. Par.* 947: 7, 300.

Clinical experience demonstrates the value of distinguishing between cancers with a structure recalling more or less the original thyroid structure and cancers which have kept nothing of the normal type of thyroid structure; therefore the authors have used the classical criterion of tisular atypism, but for general reasons have preferred to adopt the orthoplastic, anaplastic and metaplastic qualifications. However the surprising mimetism of the thyroid cell does not allow this simple distinction to include the great variety of neoformations, and various groups must be individualized, especially in orthoplastic cancer. Each of them is easily defined by its histologic characters, but it is advisable not to attach absolute importance to the differentiation of these secondary morphologic and cytologic types, since mixed tumors may be seen with the characters of two or three variants on the same slide or in different fragments. However the histologic tests which define the orthoplastic, metaplastic, and anaplastic forms are strict enough to make it possible to put each tumor in its proper place. The proposed classification is as follows:

## 1. Epithelial tumors

Orthoplastic forms may be observed as (1) vesicular epithelioma with conservation of the cellular grouping into vesicles, but malignancy is revealed by pluriestratification, rupture of the basal layer, and cellular changes; (2) papillary epithelioma with arboriscent proliferations centered on a connective tissue axis inside each vesicle; and (3) trabecular

epithelioma (a) trabeculovesicular epithelioma with small dark cells (proliferating struma of Langhans); (b) epithelioma with large eosinophilic cells; and (c) epithelioma with clear cells.

b. Anaplastic forms characterized by structural anarchy and cellular dedifferentiation with frequent monstruities. There are nearly always necrotic zones. The more or less marked atroma reaction allows persistence of large groups of cells or insinuates itself between the neoplastic elements to wall them off in varying manners.

c. Metaplastic forms: (1) epidermoid type Herrenschildt's cancer; and (2) connective tissue type touching the question of epithelioma.

3. Connective tissue tumors. They are rare: (1) fibrosarcoma; (2) lymphosarcoma and plasmocytosarcoma; and (3) reticuloendothelial tumors: reticulosarcoma, histiocytosarcoma and hemangioendothelioma.

In some cases it is possible to see phenomena of differentiation of the fundamental substance with skeletogenous metaplasia of the stroma.

It might be astonishing not to find in this enumeration the so-called metastatic adenoma. This is really a slightly peculiar asymptomatic form which, through strict clinical and histologic analysis, can usually be referred to a definite type of cancer, such as tumor of the aberrant thyroid, cancer with slow evolution, or cancer with a very localized histologic onset. The few cases in which this does not apply are solved by the notion of latent and adenomatous epithelioma, a form in which the malignant hyperplasia is masked under vesicular or trabecular adenomatous conditions. It is in such cases that the malignancy tests acquire their full value (spreading beyond the capsule and vascular invasion).

RICHARD KIMMEL, M.D.

# SURGERY OF THE NERVOUS SYSTEM

## BRAIN AND ITS COVERINGS CRANIAL NERVES

A Method of Contrasting Visualization of Brain Abscesses (Ueber eine Methode zur Kontrastdarstellung von Hirnabszessen) HANZ KOLZER. *Chirurg* 1948, 19 247

The author suggests the roentgenological visualization of brain abscesses by puncturing them and injecting roselectan (similar to diodrast) into them. This procedure is either preceded or followed by encephalography or ventriculography.

The author claims that this method would be of help in evaluating the position and the size of the abscess, its relation to the ventricle and the cortex and in determining its operative approach.

GEORGE PERRET M.D.

## SPINAL CORD AND ITS COVERINGS

Lumbar Herniations of the Nucleus Pulposus. An Analysis of 196 Operated Cases. E.S. GURDJIAN and JOHN E. WEBSTER. *Am J Surg* 1948, 76 235

The authors' report is based upon a study of 196 patients seen in the 6 year period from 1940 to 1946 and having as their main complaint low back pain with sciatic radiation. All of the patients were operated upon and an analysis of the underlying pathologic changes is presented.

A single ruptured or protruded disc was found in 146 patients. Two herniated discs were found at separate interspaces in 9 patients—usually at the fourth and the fifth lumbar interspaces. Eight patients had a massive rupture of the disc. A calcified disc was found in 5 patients. In 28 of the patients no disc protrusion could be seen. A study of the 28 patients without disc protrusion revealed the underlying condition to be varicosities of the outgoing nerve root in 12 cases, root compression by continuous tissue in 7 cases, and herniation of a cauda equina filament through a dural opening in 1 case. No disc protrusion could be made out in 8 cases. The varicosities were thought to be typical epidural hemangiomatous tissue.

The spinal fluid was examined in all cases and in the majority a slight elevation of the total protein to about 50 mgm. per cent was revealed. In only 4 cases was it above 100 mgm. per cent however it is not mentioned whether this pertained to the proved cases of herniated disc or included some of the other cases with unverified pathologic changes.

Mylography was carried out on 31 patients. An error of 25 per cent to 30 per cent was found including both the false positive and the false negative. Nevertheless it is felt that myelography is worth while, particularly in doubtful cases in order to rule out the possibility of either multiple lesions or a neoplasm.

X-ray examination is considered an important adjunct in the diagnosis to rule out the presence of either sacroiliac arthritis, spondylolisthesis, lumbal spinal arthritis, Marie Strumpell disease, metastatic lesions of the lumbar spine, tuberculosis or sacral chordoma. The authors however emphasize that a ruptured or protruded disc may coexist with spinal arthritis, sacroiliac arthritis, iliac osteitis and spondylolisthesis. A narrowed intervertebral space does not necessarily indicate the level of a ruptured disc.

The pathologic changes of the intervertebral discs were divided into the following four categories: (1) a bulge or protrusion of the nucleus through a weakened but intact portion of the posterior longitudinal ligament; (2) a rupture of the nucleus through a tear in the annulus and the posterior longitudinal ligament; (3) a degenerating nucleus and annulus fibrosis causing reflex pain but not being associated with an actual protrusion of the disc; (4) rupture of the nucleus into the bodies of the adjacent vertebrae resulting in the commonly known Schmorl's nodes.

The symptomatology may be quite variable and may or may not be associated with neurologic signs. The main complaint is low back pain with radiation of pain down the sciatic distribution. The pain is usually aggravated by coughing, sneezing or straining at stool however occasionally this aggravation of pain may not be present. Oftentimes the back ache precedes the sciatic pain by months or years but again they may have a simultaneous onset and occasionally may have only the sciatic pain. The examination usually elicits pain on straight leg raising. Pain may be aggravated by compression of the neck veins or by forward flexion of the head and neck and by bending backward or toward the lesion. Percussion at the level of the lesion usually produces typical radiation of pain. The knee jerk may be lost with a disc at the third interspace. A disc at the fourth interspace may result in weakness of the extensor hallucis longus and hypalgesia along the lateral aspect of the leg and over the big toe. A disc at the fifth interspace is frequently associated with a diminished or absent ankle jerk and a mild sensory deficit along the lateral three toes and the corresponding portion of the foot. Severe neurologic signs such as foot drop, saddle anesthesia, and sphincter disturbances are associated with massive ruptured discs at either the fourth or fifth interspace.

The operative procedure usually consists of a partial hemilaminectomy with excision of the ligamentum flavum and the ruptured disc with curettement of the interspace. In patients with severe neurologic disturbances a bilateral laminectomy is usually performed. The fourth and fifth interspaces are routinely inspected in all cases. A spinal fusion was performed by an orthopedic colleague in 28 cases by the use of a massive tibial graft. The decision to perform a spinal fusion was based upon the presence of

a spondylolisthesis unstable fifth lumbar vertebra, or a long history of backaches. It is interesting to note that the fusion was usually performed only on one side—the side opposite to the removal of the disc.

The results of treatment were classified as follows: Excellent—a complete recovery good—marked improvement with ability of the patient to return to work fair—improved but with definite residual discomfort, and poor—unimproved and not able to work. Forty three per cent of the patients obtained excellent results, 25 per cent obtained good results, 30 per cent fair, and 12 per cent, poor results. An interesting and important finding is that the results in those cases in which operation was combined with a spinal fusion were apparently no better than those in which only a small hemilaminectomy with the removal of the disc had been done.

JACK I. WOOLF, M.D.

### PERIPHERAL NERVES

#### Causalgia Following Gunshot Injuries of Nerves.

JAMES C. WHITE, WILLIAM H. HEROT and EDWARD N. GOODMAN. *Ann. Surg.* 94:3, 8, 6

The authors discuss the clinical picture of causalgia, its etiology and treatment, and present the case histories of 13 patients observed in a Naval Hospital. In their opinion the term *causalgia* should be limited to include only the sequelae of penetrating wounds of the extremities which cause injury to the nerve trunks, and the triad of (1) burning pain in the hand or foot, (2) trophic changes in the skin, subcutaneous and bony structures and (3) autonomic phenomena such as excessive vasomotor and sudomotor activity. This syndrome occurred 13 times in some 400 patients with peripheral nerve wounds representing a rate of incidence of slightly over 3 per cent. In their case histories, the authors emphasize the immediate occurrence of symptoms in these patients after the injury the importance of thermal and emotional factors on aggravation of pain, and the effectiveness of adequate sympathectomy for its relief.

Although many aspects of the causalgic syndrome suggest that it is a form of psychoneurosis, the immediate relief of symptoms following proper surgical treatment indicates that the personality disturbance is a result rather than the cause of an endurable condition. The immediate occurrence of the syndrome after injury eliminates sepsis, ascending neuritis, anoxia, compression of the nerve by scar tissue, or the formation of a neuroma as etiologic factors. Injury to a major blood vessel was present in only 3 of 13 patients.

It was found that a quiet, warm environment, ingestion of alcohol, sleep, and afebrile states increased the comfort of these patients. Questioning of the patients revealed that the burning pain and hyperesthesias were aggravated by cold, damp or very hot weather, cold air on the affected hand, loud or unexpected noises, annoying radio programs, jarring of the bed, excitement, harrowing movies or stirring

music, crying children, hypodermic injections into any part of the body arguments with other patients, physical exertion, defecation and urination, drinking anything cold, and laughing. The single common denominator which underlies these diverse irritants was a burst of sympathetic impulses emitted from the hypothalamus and causing vasomotor, pilo-motor and sudomotor responses in the hand and fingers, and in the toes and soles of the feet. These areas show the greatest evidence of autonomic activity and produce nervous sweating and vasoconstriction. There is no valid evidence that the sympathetic system plays any direct role in the central conduction of painful stimuli. It is, therefore, the authors' contention that the hyperesthetic state is caused and aggravated by autonomic impulses released at the hypothalamic level in response to thermal and psychic stimuli and distributed over efferent sympathetic neurones permitting a direct irritation of sensory afferent fibers at the site of nerve injury.

Total sympathetic denervation of a limb is an effective method for the relief of true causalgia. Failure in producing complete relief of pain is due to incomplete sympathetic denervation. It is emphasized that the area of denervation must reach well above the level of nerve injury. If there is temporary relief of pain following a diagnostic procaine block the patient should be operated upon at an early date before he has become dependent on narcotics, and especially before he has developed neurotic tendencies or irreversible atrophic changes in his bones and soft tissues. Preliminary neurolysis is totally ineffective and, if indicated, should be undertaken after the sympathectomy. Primary local surgery is recommended only if a foreign body is in contact with the nerve or when a septic focus is present.

In 4 patients a complete paralysis of a neighboring nerve trunk was also present after sympathectomy. Vasodilation was complete only in the area of intact peripheral nerve supply and the adjoining paralyzed areas remained cooler and somewhat cyanotic, possibly due to hypersensitivity of the denervated smooth muscles to sympathomimetic hormones. The paresthesias and milder hyperesthesias which accompany sensory nerve regeneration are not necessarily relieved by sympathectomy. These latter symptoms are mild and not influenced in any way by hypothalamic stimulation and increased sympathetic discharges.

GEORGE PERRET, M.D.

The Role of Foreign Body Reaction in the Healing of Peripheral Nerve Injuries Due to Gunshot Wounds (Zur Frage der Heilung schussverletzter peripherer Nerven mit besonderer Berücksichtigung der Hautregeneration und Bedeutung der Fremdkörperreaktion). EDWARD RANDEKATZ, *Chirurg.* 94:7 17-18: 241.

The author found that functional results were often poor following gunshot injuries of the periph-

eral nerves because of inflammatory processes and an increase in the amount of scar tissue resulting from foreign bodies. He studied the operative material obtained from 950 peripheral nerve lesions due to bullet or shrapnel wounds from 2 to 44 months after the injury. He found foreign objects imbedded in the nerve scar in 485 or 51 per cent. of the cases. Even after 20 months an active inflammatory process could be found around foreign material and scar tissue within the nerve segments. The most common foreign bodies were particles of clothing, plant fibers, wood splinters, earth particles and stone and bullet fragments. Oftentimes the foreign body reaction with increased production of scar tissue was caused by bandage or suture material. The foreign bodies were most frequently encountered in wounds produced by shrapnel fragments and were relatively rare in direct bullet wounds.

GEORGE PERRET, M.D.

### SYMPATHETIC NERVES

Temporary Interruption of the Sympathetic Impulses to the Head by Infiltration of the Cervical Sympathetic Trunk. HOWARD KIRCH and ADRIAN F. REED. *Ann. Surg.* 1945 128: 101

The value of a transient interruption of the sympathetic impulses to the upper extremity and the head is now well recognized both therapeutically and in prognosticating the reaction to surgical interruption of these pathways. The more commonly accepted procedure of injecting or infiltrating about the cervicothoracic ganglion is a very satisfactory procedure and comparatively benign. However there are several potential complications which must be considered. These include the possibility of puncture of the apex of the lung, injury to the brachial plexus and puncture of the large vessels of the lower portion of the neck. In blocking the sympathetic impulses to the head a much simpler procedure would be to inject the sympathetic trunk at the level of the tuberosities of the fifth or sixth cervical transverse processes.

In order to elucidate this problem the authors performed a dissection of the sympathetic trunk on 33 cadavers. It was found that at the level of the fifth and sixth cervical vertebrae the sympathetic trunk lies on the longus colli muscle medial and

slightly anterior to the fibers of the scalenus anticus muscle, in a small compartment formed by a splitting of the prevertebral fascia. It is posteromedial to the carotid sheath and its contents. The constant relationship of the sympathetic trunk and its proximity to the easily palpated carotid tubercle and the anterior tuberosity of the transverse process of the fifth cervical vertebrae makes this a uniformly successful approach.

The technique advocated is to have the patient assume the supine position with the head flexed and turned slightly to the opposite side. This permits easier palpation of the tuberosities of the transverse processes of the fifth or sixth cervical vertebrae and permits easier retraction of the carotid sheath and its enclosed vessels medially. In a slender person a small hypodermic needle may be used throughout; however in a heavier individual a 21 gauge venous puncture needle will suffice. The needle is usually inserted along the posterior border of the sternocleidomastoid muscle (which is retracted medially with the carotid) and is then advanced until it is in contact with the lateral surface of the tip of the transverse process. After withdrawing it slightly it is reinserted along the anterior surface of the tuberosity. At a depth of approximately 5 cm. from the lateral extent of the transverse process the injection is performed. Although the possibility of entering the intervertebral foramen is extremely slight nevertheless it is mandatory that aspiration be performed before the solution is injected. The injection may be performed by retracting the sternocleidomastoid muscle and the carotid sheath laterally; however this produces more discomfort to the patient. A successful block is usually obtained after 3 to 5 c.c. of a 1 per cent solution of procaine hydrochloride has been injected, although it may be necessary to inject up to 8 or 10 c.c.

The authors have used this technique approximately 350 times with satisfactory results. There have been no significant sequelae; however a patient may complain of slight pain on insertion of the needle or hoarseness due to infiltration about the recurrent laryngeal nerve. Repeated injections, however, resulting in increased vascularity with hypertrophy of the lymphoid tissue, may slightly complicate a future surgical procedure on this portion of the sympathetic trunk. JACK I. WOOLFE, M.D.

# SURGERY OF THE THORAX

## CHEST WALL AND BREAST

Breast Tumors with Local Malignancy Giant Fibroadenomas, So-called Phylloides Adenomas, and Recurring Adenomas (Les tumeurs du sein malignité locale fibro-adenomes géants, adenomes dits phylloides et adenomes récidivants) P. SARRT M. DARGENT and A. MAKHELOU *Lyon chir* 948, 45: 504.

Eight cases of breast tumor are reported. The largest of the enucleated tumors weighed 2 700 gm. The rapid growth, skin ulceration, progressive enlargement during menstruation and pregnancy and frequent recurrences after extirpation—up to seven times in one case—in these cases simulated cancer. However the absence of regional adenopathy and of metastases in other organs, as well as the absence of cachexia, proved that the tumor was only of local malignancy not a true carcinoma or sarcoma. It is characteristic of these tumors that they reach a very large size one weighing 7 500 gm. being recorded.

Although carcinomatous degeneration of fibroadenomas is rare treatment with androgenic or estrogenic hormones may be dangerous and is contra indicated. WERNER M. SOLWITZ, M D

Th Prognostic Significance of Early Diagnosis in Breast Cancer STIGVARD KARL *Acta rec d Stockh* 948, 10: 475

This study is based on 500 cases of breast cancer and Paget's disease of the nipple seen at the Radium Center in Copenhagen between June, 944 and December 1946. These were all verified histologically except one which was clinically unmistakable and the patient died with metastases.

There were 17 cases of Paget's disease of the nipple in 2 instances associated with a carcinoma. Two cases of sarcoma of the breast were seen. There were 5 cases of carcinoma of the male breast. Among the 476 other cases, there was one patient who had had a breast tumor for 46 years so the factor of delay could not be accurately appraised and she is excluded in the final analysis.

The author personally interrogated the subjects included in the statistical series. The cause of delay in seeking medical advice after recognizing signs or symptoms of breast cancer was essentially ignorance of the possible gravity of the situation or fear that an unfavorable diagnosis would be rendered upon examination. The delay in coming to adequate treatment was sometimes the patient's fault, but also at times due to lack of energetic action on the part of the examining physician.

The significance of such delay has long been recognized and can be appreciated in the accompanying table, which illustrates the relation between delay and operability and between delay and the stage of disease when appropriate treatment was actually instituted. In this table cases in stage I are those

TABLE I—SHOWING THE RELATION BETWEEN DELAY AND OPERABILITY AND BETWEEN DELAY AND STAGE OF DISEASE WHEN TREATMENT WAS INSTITUTED

Delay	No of Cases	Technically operable	Radically operable in the technically operable	Cases in which radical operability was not determined	All cases		
					Stage		
					I	II	Inoperable
Works or less	24	100	61	58	58		
Weeks—Month	89	84	65	56	53	4	5
1—2 Months	9	89	87	8	43	46	
3—6 Months	40	77	77	40			1
Over 6 Months	90	7	18	58	41	30	39
Total	475	89	84	7	44	4	5

without demonstrable axillary metastases and those in stage II are those with demonstrable axillary metastases.

The increase in cases in stage I occurring with a delay of over 12 months is presumed to be due to a greater number of slow-growing late metastasizing tumors in this group. The cause for nonoperative treatment in the technically operable group was either refusal by the patient, advanced age or severe intercurrent disease. Education is believed to have already produced results but the author concludes "What is gained prognostically by the patient seeking medical advice early ought not to be lost by failure to have the diagnosis established at once."

HIRSH T. LANGSTON, M D

## TRACHEA, LUNGS, AND PLEURA

Parietal Complications of Collapsed Therapy (Complications pariétales de la collapsothérapie) A. BRYNOR R. GORAN, and L. MARICAUVE *J fr méd chi thorac*, 1948, 30

Patients who have undergone thoracoplasties often suddenly develop a serious pleural complication followed by infection of the thoracic walls. This complication may occur a long time after the operation. According to some statistics as many as 30 per cent of such patients die of the complication.

The authors had the same experience in their practice until they began to use forced aspiration and at a time when penicillin was unknown.

They have been able to bring about cures by evacuating the pus with simple pleural punctures, with or without the insufflation of air or lavage, or without

producing an oleothorax. They report cases in which the patients were cured by these simple means.

Not all abscesses are due to tuberculosis. The septic abscesses respond well to the sulfa drugs and to the antibiotics. Three of the authors' patients were successfully treated with penicillin. All of these had a large abscess of the chest wall following thoracoplasty.

Tuberculous abscesses of the thoracic wall still constitute a grave complication of collapse therapy. They may remain localized for a long time but they often pursue a progressive course spreading according to gravity from above downward most often but at times backward if the patient is confined to bed. They may spread out from a pleurotomy opening following the intercostal spaces or even spread in the most diverse directions forming the most unexpected fistulous tracts. These tracts are capable of giving rise to suppurative mediastinitis, caseous mediastinal adenopathies, esophagopleural fistulas, ulceration of the great vessels (e.g. the subclavian artery), areas of costal osteitis (vertebral or sternal) and caseous pleurisy.

Whenever possible the abscess, even a very large one, should be removed *in toto*. After complete removal of the abscess plastic repair of the defect should be carried out. If one finds a fistulous tract at the bottom of the wound in the course of surgical intervention it should be thoroughly removed and the caseous area should be thoroughly cauterized. Treatment with penicillin should then be instituted.

In the case of multiple tracts in varied directions it may be impossible to remove them all even by total ablation. This is true particularly when the tracts extend into the scapula. The therapeutic result will be incomplete and followed by recurrence.

Before employing surgery one should always try the sulfa drugs or better penicillin. One will be surprised to see the abscesses promptly disappear.

When medical treatment has failed and forced aspiration has proved unsatisfactory a well planned surgical procedure is necessary.

BLACKWELL MARKHAM, M D

**Pulmonary Decortication for Chronic Posttraumatic Hemothorax; Constricting Pleura (La décortication pulmonaire pour hémithorax post-traumatique chronique; pleurite constrictive). A P. NAY.**  
*Helv. chir. acta* 1945 15 190.

Chronic organizing hemothorax, infected hemothorax and hemothoracic empyema are dangerous posttraumatic sequelae. The time when these disorders were treated by mutilating thoracoplasties of the Schede-Estlander type is now gone. Decortication and total pulmonary mobilization alone allow satisfactory healing and nearly complete restitution of functional integrity. This operation which was already performed toward the end of the past century has been adopted and improved by the Anglo-American war surgeon. Modern decortication was performed for the first time by Burford in May 1943 and more than 1,500 operations have been done since

then with excellent results and a mortality below 2 per cent. However this impressive result should not obscure the fact that decortication is a serious intervention which like any modern type of intrathoracic surgery requires definite conditions for its success.

Successful decortication in a few isolated cases of chronic or subacute purulent pleurisy has again demonstrated the importance of obliteration of the empty pleural space by re-expansion of the lung to avoid eventual pleural suppuration. This can be compared with the capital role played by immediate pleural obliteration after partial pulmonary resection. It is impossible to overemphasize the importance of re-expansion of the remaining pulmonary parenchyma to avoid postoperative empyema.

Some technical details are very important. The pleural plane of cleavage must be established exactly to allow blunt dissection without tearing of the intact visceral pleura, and during dissection the pressure must be exercised toward the shell and not toward the pulmonary surface. A pulmonary segment or an entire lobe may be in exceptionally bad condition and pulmonary segmental resection or lobectomy may be necessary. The whole lung from apex to diaphragm on the mediastinal side and at the fissures must be liberated and the parietal surface of the diaphragm must also be decorticated and the costodiaphragmatic and cardiophrenic sinuses developed. This will allow circumferential re-expansion of the lung in all directions. In general decortication of the parietal pleura is not recommended because it causes hemorrhage which is difficult to stop. Several intercostal drains are used and connected to a strong and continuous aspiration apparatus. If there is no intra-pleural suppuration the drains are removed as soon as the lung adheres to the chest wall between the second and fifth days. Positive pressure respiration with an anesthesia apparatus during the first postoperative days is very useful. Penicillin given by the general route by aerosol inhalation and by intra-pleural irrigation offers valuable protection. Voluntary exercises of unilateral respiration, intense thoracic gymnastics and relatively early ambulation are essential factors in the recovery of patients with thoracic injury.

RICHARD KEMEL, M D

**An Improved Method of Resection of Pulmonary Segments. RICHARD H. OYERBOLT, FRANCIS M. WOODS, AND KERVEY H. BETTE.**  
*J. Thor. ac Surg* 1945, 17 464.

The development of the concept of the lung as a segmental organ is briefly traced and the importance of preserving at operation the healthy portions of lung is emphasized. The technique developed by various other authors is described. Since the present authors found certain objectional features in these methods they evolved a technique to overcome them.

Each bronchopulmonary segment is provided with a bronchial and arterial supply and a venous return all of which are consistent in pattern. The artery, vein and bronchus form the segmental hilum. These

structures and the pleura covering the segment are the important elements binding one segment to its neighbor. The intersegmental surfaces within a lobe of lung are made up of a loose areolar plane. The arterial and bronchial supply does not, typically cross this intersegmental plane although a few venous channels may.

In segmental resection, the arterial and venous channels at the segmental hilum are divided accurately. The segmental bronchus is then isolated, clamped and divided proximal to the clamp. The stump is closed with interrupted sutures tied over the end. With traction on the distal stumps of the divided hilar elements, the segment in question is snipped from its neighbor. This maneuver is aided by a digital or gauge dissection along the intersegmental plane. This line of demarcation is determined by differential inflation under increased intrabronchial pressure supplied by the anesthesiologist wherein the intact adjacent segment will freely aerate in contrast to the atelectatic segment undergoing resection. The pleura is finally divided when it is reached by this dissection.

No special treatment is required for the intersegmental plane since there will be no significant air leak if an accurate separation has been done. A few intersegmental veins may require ligation.

This method has been used in 30 segmental resections in various combinations. Fifty-nine resections were carried out on 50 patients for bronchiectasis and 11 were done for other indications. In the bronchiectatic group there were 6 additional total lobectomies. The patients ranged in age from 7 to 55 years. The nonbronchiectatic indications included tuberculosis, chronic lung abscess, pulmonary cyst, benign tumor and metastatic tumor.

The only death occurred as the result of a hemothorax produced by perforation of the pulmonary artery by a stainless steel wire suture used to close the bronchus. This suture material is no longer used. There were empyemas in 23 per cent of the 50 patients resected. Reoperation because of persistent pneumothorax was required three times. The segmental surface was responsible for this situation in 2 instances and the bronchial stump once. Whereas the complications are greater than in total lobectomy the conservation of lung tissue is believed to compensate adequately for this. The end results have been entirely satisfactory.

The text is supplemented by many semidiagrammatic illustrations. **MURAN T. LANGSTON, M.D.**

#### HEART AND PERICARDIUM

Dysphagia Lusoria: Right Sided Aortic Arch. **W. N. MANN.** *Guy's Hosp Rep Lond.*, 94, 96, 60.

The term dysphagia lusoria means dysphagia from a "sport" of nature and has been used to describe examples of pressure on the esophagus from a right aortic arch.

The location of the aortic arch on the right side is a rare congenital anomaly. Maude Abbott having

found only 14 examples in 1,000 cases of congenital heart disease. Three varieties have been described. In the first type, which is not common, the right fourth arch persists to form the aorta while the fourth left arch persists to form the left subclavian artery which passes across in front of the esophagus and trachea. The second variety is the most common. Here the right fourth arch persists to form the aortic arch with the right dorsal aortic root. The left fourth arch disappears or is represented by a fibrous band, but the left dorsal aortic root persists and is joined to the left pulmonary artery by the ductus arteriosus and gives origin to the left subclavian artery. Because this "persistent left root" is dorsal in position, the left subclavian artery arises posteriorly and does not lie in front of the esophagus and trachea. Through the attachment of the persistent left root to the ductus arteriosus and the left subclavian artery the "right" or definitive aorta is pulled to the left behind the esophagus. The esophagus is thus displaced forward and to the left, and its lumen partly occluded by pressure from the diverticulum.

The third variety which is very uncommon, is persistence of both the left and right fourth arches with both dorsal aortic roots so that the esophagus and trachea are enclosed in an arterial circle.

Symptoms from uncomplicated right aortic arch are unusual. When present they may be dysphagia, parasthesias in the left arm, or dyspnea. Symptoms are more severe in cases of double aorta.

The author describes the case of a 37 year old woman who was studied because of difficulty in swallowing. Roentgenological studies showed the esophagus to be pushed forward and to the left. The right border of the great vessels was unusually prominent and curved toward the right. On the left, in the position of the aortic knuckle was a triangular shadow which was taken to be the blind end of the dorsal remnant of the left aortic arch. Tomography showed a connection between the persistent left aortic root and the left pulmonary artery the ligamentum arteriosum. The interpretation is that this patient suffered from right-sided location of the aorta of the second type described. She was relieved of her symptoms by simple conservative measures without operation. **JAMES E. THOMPSON, M.D.**

#### ESOPHAGUS AND MEDIASTINUM

The Surgical Treatment of Carcinoma of the Thoracic Esophagus. **LYMAN A. BREWER, III, and FRANK S. DOLLEY.** *Read J Surg*, 94, 56, 317.

This article is a report of 30 proved cases of carcinoma of the esophagus, in 23 of which thoracoscopicotomy was done. Twenty two of the cancers were located at, or just below, the arch of the aorta. Eight were just above the diaphragm. Diagnosis is made on the history of dysphasia, usually progressive but sometimes with periods of remission. Frequently there was regurgitation of food as well as loss of weight and strength. A clinical picture of starvation

is the outstanding physical finding. Roentgenological examination and esophagoscopy confirm the diagnosis. Pathologically, squamous cell carcinoma (65 to 95 per cent) and adenocarcinoma (5 to 30 per cent) are found. Approximately 20 per cent of these lesions are located in the upper third of the esophagus, 37 per cent in the middle third, and 42.8 per cent in the lower third. Local spread to adjacent organs and lymph node metastases are of prime importance. Lesions at the arch or above spread to the trachea, bronchi, aorta, and mediastinum. Lymphatic spread is to the mediastinal nodes primarily although the cervical nodes are sometimes involved. In association with some lesions in the midthoracic esophagus subdiaphragmatic lymph node metastases are seen. Thus a combined thoracoabdominal approach is advisable. The contraindication is definite evidence of extensive spread of the tumor most commonly to the mediastinum.

The author describes his method of preoperative preparation and several methods of treating these lesions. His technique consists of an S-shaped incision at the level of the fifth rib posteriorly and extending down to the seventh rib and on to the abdomen. The mediastinum is explored for metastases and evidence of inoperability and the diaphragm is operated upon after the phrenic nerve is crushed. The stomach is then freed care being taken with the main branch and anastomotic arches of the gastropiploic artery. The right gastric artery is identified and preserved. The remainder of the esophagus is then mobilized care being taken not to injure the thoracic duct. After novocain injection, the vagi are cut. For high anastomosis the esophagus is divided at the cardia. However in lower lesions a portion of the stomach may have to be removed. The esophagus is then pulled up behind and above the arch of the aorta. Open anastomosis between the esophagus and the stomach is done with a layer closure of interrupted fine silk sutures. The fundus is used for the anastomosis a ring 2 cm. in diameter being used. The anastomosis is reinforced by the gastrocolic omentum which had been previously saved. The Levine tube is kept proximal to the anastomosis. The stomach is tacked to the parietal pleura from the arch of the aorta to the diaphragm. The chest is closed with catheters inserted and under water" closed drainage is used. The patient is allowed to swallow water after a period of about 48 hours.

The importance of postoperative thoracic complications is emphasized. Two of the patients in this series developed wound infection which responded

promptly to drainage. The 2 operative fatalities occurred following resection above the arch of the aorta. Both of the patients had arteriosclerotic heart disease and auricular fibrillation. In this series 23 of 30 were explored and only 9 or 30 per cent were subjected to resection. The authors point out that the risk of transthoracic laparotomy in properly prepared patients is very small. Recently they have used postoperative supravoltage roentgen therapy over the areas previously involved with cancer in cases of squamous cell carcinoma. It is too early to state whether or not this treatment will increase the length of cure following operation.

ROBERT E. FLOREN, M.D.

**Esophageal Resection with Intrathoracic Esophagogastronomy for Carcinoma in the Middle Third of the Esophagus (Carcinoma do esôfago médio-torácico. Esofagotomia parcial e esofagogastronomia intratorácica.)** HAROLDO A. RODRIGUES. *Rev. Brasil. Cir.* 1948 17 51

This is a very detailed case report of a 57 year-old white man whose presenting complaints were dysphagia and vomiting of 3 months duration. An obstructing lesion of the esophagus was found on roentgenographic examination. No biopsy was obtained. On May 20, 1948 an exploratory thoracotomy revealed an esophageal tumor 5 by 3 cm in size which was located 8 cm. above the diaphragm. The esophagus was resected. The stomach was mobilized and an esophagogastric anastomosis was performed just below the aortic arch. The chest was closed with drainage. The lesion was a squamous cell carcinoma. Regional nodes were removed along with the esophagus and these were found to contain metastasis. The patient survived the procedure without significant complications.

The author traces the development of the present day technique of management in carcinoma of the esophagus and points out that this was the first successful resection for a lesion in the midesophagus performed in Rio de Janeiro.

During the first 10 days after operation the patient was kept in a head-down position. This was thought to favor evacuation of the tracheobronchial secretions prevent the swallowing of pharyngeal secretions avoid pendant traction on the line of anastomosis, and improve the peripheral circulation. Mouth feeding was withheld for 10 days. The closed drainage tube from the pleura was removed on the eleventh day. A course of deep roentgen therapy was given to the mediastinum.

HIRAM T. LANGSTON, M.D.



# SURGERY OF THE ABDOMEN

## ABDOMINAL WALL AND PERITONEUM

Contribution to the Study of Strangulated Inguinopropertitoneal Hernia (Contributo allo studio delle ernie inguinopropertitoneali strozzate) ARMANDO BIANCHI *Riv. ital. chir.* 948, 35: 3

The author reviews his experience with 3 cases of inguinopropertitoneal hernias which are considered of rare occurrence and which represent 0.32 per cent of the hernias encountered at his clinic.

The characteristics of this type of hernia are presented. Such hernias may be composed of a single sac situated between the transversalis fascia and the peritoneum and always in the vicinity of the inguinal region or they may possess two sacs one external inguinal the other internal propertitoneal. There are three varieties: (1) iliac, when the sac is lateral and superior to the inguinal ring and thus in the iliac fossa; (2) vesical, when the sac is situated medial to the ring and near the urinary bladder; (3) pelvic or obturator when the sac is situated between the peritoneum and the pelvic wall near the obturator foramen. When two sacs are present they may have a common abdominal opening or the openings may be distinctly separate although, usually, close together. The opening is usually surrounded by rigid fibrous tissue. The size of the sac varies from that of a small nut to that of a fetal head or larger. The contents may be small bowel and omentum, or omentum alone. The alterations following strangulation, are caused by the action of the ring, represented by the abdominal ostium.

Of the 3 hernias seen by the author 2 showed strangulation and one of these was treated by resection. In both cases the sac was first opened by a rectus incision. After the hernia was reduced and the internal ring closed a regular Bassini repair was resorted to in the case not requiring bowel resection. The third case was complicated by small bowel perforation and abscess formation. A resection was performed with excision of as much of the sac as possible. Three layers of suture were used. The abdominal wall was then closed in layers. After a stormy convalescence the patient recovered and was discharged. A few days later (21 days after operation) he returned with a recurrence of obstructive symptoms. There were signs of wound infection and segmental dilatation of the bowel, which, with the presence of ova in the stool, was diagnosed as ascariasis. The patient was treated conservatively with local heat and anthelmintics with good results. He returned a month later with similar symptoms. Following local heat applications drainage was established and 2 large worms were found. Later fecal matter was discharged which when injected showed communitation with the transverse colon. Healing occurred without surgery. In 25 days.

LUCIAN J. F. O'DWY, M.D.

The Value Derived from Utilizing the Component Parts of the Transversalis Fascia and Cooper's Ligament in the Repair of Large Indirect and Direct Inguinal Hernia. DAN C. DONALD. *Surgery* 1948, 24: 662.

Recurrences following the standard (Bassini) operation for large oblique and direct hernias prompted the employment of an operation utilizing the component parts of the transversalis fascia and allied ligamentous structures in such cases. In 116 cases of large oblique recurrent and direct hernias in which this procedure was employed, questionnaires sent to the patients showed that there has not been a single recurrence of hernia with all questionnaires answered except three which were returned as undelivered.

The pathology of all inguinal hernia is not the same. To obtain the maximum results in the operation for inguinal hernia, it is necessary to consider the pathologic changes that accompany the different types of hernias in the inguinal supportive tissues. Since the transversalis fascial support is not involved in the small oblique hernia, usually seen in children, the treatment consists simply of the removal and closure of the patent processus vaginalis (sac) down to the fold of the peritoneum, and closure of the lateral abdominal ring as in the Bassini operation.

The chief pathologic features in large oblique and direct hernias are the giving way of the transversalis fascial support and varying degrees of dilatation of the internal abdominal ring. Operations for these hernias should be directed toward restoring these structures to a normal state.

Special emphasis is placed on the importance of including the iliopectineal tract in the suture line for closure of the transversalis fascia, to maintain the lateral support of the fascia. In the oblique hernia, the dilated internal abdominal ring should be closed by identifying its arms and approximating them with interrupted sutures above the spermatic cord.

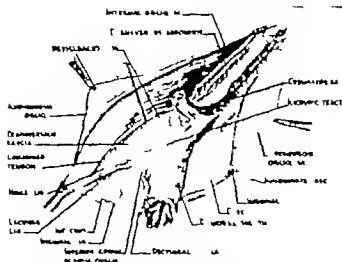
In the operative management care should be taken to maintain hemostasis, thus preventing hematoma and serum accumulation which might invite infection and weaken the tissue support, and to avoid unnecessary trauma of the tissues, including the nerve supply which might result in weakened muscles. The operative field should be cleared of areolar and adipose tissues and straggling muscle fibers, for good visualization and prevention of their incorporation in the suture line which would weaken ligamentous support.

CHARLES BRADY, M.D.

## GASTROINTESTINAL TRACT

The Gastric Mucosa after Vagotomy for Peptic Ulcer: A Gastroscopic Study. LEONARD M. ASH. *Gastroenterology* 948, 11: 302.

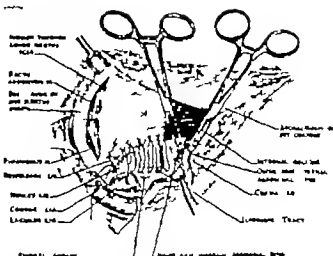
In order to evaluate the effect of vagotomy on the gastric mucosa, 20 patients were studied gastroscopically.



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Fig 1 (Donaid) The transversalis fascia in the inguinal region. Relationship of iliopectic tract, transversalis fascia, and femoral sheath is shown. Inguinal ligament and fascia lata have been cut and reflected. The transected muscular portions of the internal oblique and transversus abdominis muscles are reflected to show the lateral portion of the transversalis fascia as it is continuous with the femoral sheath below. The separation of the conjoint tendon into its component parts (the transversus abdominis and internal oblique muscles) is shown. Henle's ligament is an inferior lateral expansion of the enveloping fascia and tendon of the rectus muscle blending and continuous with the iliopectic tract and femoral sheath.

Fig. 2 (Donald) First row of sutures. Three sutures are placed 1 to 3 cm. apart through Hasselbach's ligament and



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Hensle's ligament above, and Cooper's ligament and the lacunar ligament below including the medial part of the iliopectic tract. The third suture is the last one incorporating Cooper's ligament. The remaining sutures approximate Hesselbach's ligament to the iliopectic tract up to the level of the internal abdominal ring. In cases in which Hesselbach's ligament above is thin, the aponeurosis of the transversus abdominis muscle is included in the suture bite. In this drawing a vertical relaxing incision has been made in the part of the anterior rectus fascia posterior to the external oblique aponeurosis. The inguinal ligament is not shown. The two arms of the internal abdominal ring have been identified and brought into view with Allis clamps preparatory to their approximation with interrupted sutures above the spermatic cord.

The presence of a gastroenterostomy which functions well serves to protect the gastric mucosa from traumatic factors by permitting more rapid gastric emptying and by allowing the reflux of alkaline small bowel contents. This accounts for the relatively smaller incidence of gastric changes in the cases in which a gastroenterostomy was done at the time of the vagotomy.

SAMUEL KAHN, M.D.

Phlegmonous Gastritis of Staphylococcal Origin  
Partial Gastroectomy Massive Sacral Echar  
Caused by Postoperative Pyemia. Failure of  
Penicillin Therapy (Gastrite phlegmoneuse à  
staphylocoques. Gastrectomie segmentaire. Echarre  
sacrée massive et rapide par pyohémie postopéra-  
toire. Echec de la pénicilliothérapie). R. JOURNÉ  
*Mém. Acad. chir. Par.* 1948 74 415

The author reports the case of a woman 50 years of age who complained of neuralgic pains in the left subcostal region of 8 months duration. Towards the end of this period she developed fever. A large tender mass adherent to the thoracic wall was palpable. Laparotomy revealed that the mass consisted of a large abscess in the anterior stomach wall which was surrounded by adhesions involved the small omentum and the gastrosplenic ligament, and was closely fixed to the thoracic wall. The pus contained staphylococci. Treatment consisted of partial resection of the stomach.

Postoperatively a large gangrenous slough developed rapidly in the region of the sacrum and the patient died 5 days after the operation in spite of continued penicillin therapy.

**Abstractor's note.** It should be mentioned that the dosage of penicillin (800,000 units daily) appears rather low in view of the severe condition.

WILHELM M. SOLARZ, M.D.

**Clinical Considerations of Massive Gastroduodenal Hemorrhages (Considerazioni cliniche sulle grandi emorragie gastroduodenali).** ELIO PAVIERI and G. SANTAREM. *Riv. intern. clin. ch.* 948, 3 305.

The authors review the literature and analyze 43 cases of massive hemorrhage observed among 451 patients with peptic ulcer who were treated from 1934 to 1947 at the Surgical Clinic of Pisa.

They believe that treatment of the first attack of hemorrhage should follow a medical régime. One should resort to surgery only when the hemorrhage is profuse, repeated, and uncontrollable and only when from the history and clinical picture, and (better still) from previous radiologic examinations, one finds that he is dealing with hemorrhage from a calloused or penetrating ulcer.

From numerous and various experiences, the authors have formed two axioms: (1) rarely is the first hemorrhage mortal and (2) "repeated hemorrhage aggravates the prognosis."

When surgery is resorted to the procedure of choice is gastroduodenal resection which is well tolerated by the patient and offers the surest form of hemostasis. Gastroenterostomy, cauterization and consecutive invagination of Balfour should be considered only rarely.

When, after repeated transfusions, there is no improvement in the cell count and hemoglobin within 24 to 48 hours, surgery is performed following a rapid and fitting preparation of the patient.

LUIGI J. FROMOTTI, M.D.

## LIVER, GALL BLADDER, PANCREAS, AND SPLEEN

**Anatomicopathologic and Functional Changes in the Biliary System Following Cholecystointrofflexion (Modificazioni anatomicopatologiche e funzionali delle vie biliari in seguito alla colecistointrofflessione).** CARMELO SPANZARATO. *Polichir.* sez. chir. 948, 55 125.

The author attempts to simplify biliary surgery by trying to eliminate the cavity of the gall bladder without excising this organ. The procedure consists of exposing the fundal half of the gall bladder and placing a purse string suture about the middle. After this the fundus is invaginated and the suture tied. This is followed by a second suture inverting the gall bladder still further.

A brief review of the literature follows, with a description of the different methods of handling the gall bladder, including those of Loreta, Mayo, and Thorek. Only one author, J. Lambret, has used a

method similar to that used by the author. Lambret invaginated the fundus of the gall bladder for atasis and atony. His work differs in that he tries to reduce the size of the gall bladder whereas the author attempts to eliminate the cavity entirely.

The author has performed this operation on 8 dogs and describes each operation in detail. This includes the cholangiogram reports, the pressure readings of the different parts of the biliary system at a second operation, and the histologic study of sections from the gall bladder and liver.

The results obtained show that it is not possible to obliterate the cavity of the gall bladder entirely although it was reduced to as much as, and even less than 10 per cent of the original size. Moderate dilatation of the remaining gall bladder often occurred but in only 1 case was it appreciable enough so that it could be referred to as cholecystic regeneration as reported by Balice and others.

The invaginated mucosa shows atrophic changes aside by side with proliferative changes. The cause for this is not understood but the changes may represent an attempt at regeneration.

The remaining ducts undergo dilatation which, however, is not constant, and there is usually an increase in pressure. Oddi maintained that there was a primary period of atony lasting 1 month followed by hypertonicity of the sphincter when cholecystectomy was performed. The findings in these experiments, however, showed a normal hypotonic, or hypertonic status of the sphincter of Oddi during the first month.

The hepatic cells showed degenerative changes which diminished or were even absent as the time interval following operation increased.

LUIGI J. FROMOTTI, M.D.

**Differential Diagnosis Between Medical and Surgical Jaundice by Laboratory Tests.** H. V. POWERS and FREDERICK STEIGMANN. *Ann. Int. M.* 1948, 29 460.

The first problem in the differential diagnosis of the jaundiced patient is the distinction between the presence or absence of liver cell damage, and of marked interference with the bile flow. In general, the patient with medical jaundice has impairment of liver cell function, the patient with surgical jaundice has marked interference with the bile flow.

The follow-up studies of a large number of patients with an established diagnosis of jaundice permits an evaluation of liver function tests indicative of liver cell damage. At least two of the tests should be positive, before the presence of liver cell damage can be established, since every one of the tests may yield biologically false results occasionally.

In 135 cases, a combination of the thymol turbidity test with either the cephalin-cholesterol flocculation or the albumin-globulin ratio permitted recognition of liver cell damage in two-thirds of the cases. A combination of the cephalin-cholesterol flocculation test with the albumin-globulin ratio permitted this in a slightly smaller number of cases. If two posi-

tive results in all three tests were accepted, 83 per cent of the cases were correctly classified. The addition of the cholesterol-cholesterol ratio i.e. at least two positive results in the four tests raised the percentage of correct diagnoses significantly. The results of urinary urobilinogen determination from sulfalein retention and hippuric acid synthesis added only a few more cases. In the vast majority of cases, therefore, liver cell damage can be diagnosed by means of four tests: cephalin-cholesterol flocculation, thymol turbidity, albumin globulin ratio and cholesterol-cholesterol ratio. The thymol turbidity test reduces the number of other more complicated tests required to classify cases correctly.

One test denoting marked bile flow interference was considered sufficient to indicate that phenomenon. In one third of 134 cases absence of urinary urobilinogen was the only positive test. In combination with other tests this absence was demonstrated in two-thirds of the cases. Marked elevation of the serum alkaline phosphatase alone was found in a relatively small percentage. If one positive test in the determination of either urinary urobilinogen or of serum alkaline phosphatase, or of both was used as a criterion almost all cases in this group were accounted for.

One is struck by the frequent concurrence of both liver cell damage and marked bile flow interference—in 34.7 per cent of the cases studied. The previously stated premise that in medical jaundice there is only liver cell damage, and that in surgical jaundice as a rule there is only marked bile flow interference is therefore incorrect in a significant number of cases. Of the medical cases 26.3 per cent were complicated by marked interference with the bile flow. Of the surgical cases 60 per cent were complicated by liver cell damage.

SAMUEL KAHN, M.D.

Acute Torsion of the Gall Bladder. FRANCIS A. HAINES and JOHN T. KANE. *Ann Surg* 1948, 129, 253.

Acute torsion of the gall bladder is an entity which is seldom mentioned in American literature. It occurs predominantly in elderly people, particularly of the viscerotonic type. As late as 1946 only 76 cases had been reported. As would be expected torsion occurs in those cases in which the gall bladder is free and completely surrounded by peritoneum. The relation between torsion and the movement of normal peristalsis in the transverse colon is mentioned also. Loss of elasticity of supporting structures may be a factor; stones do not seem to be an associated complication. In most cases the onset is acute, with sudden severe right upper quadrant pain which may radiate to the back. Vomiting is a frequent finding. The mass felt in more than half of the cases, is usually tender; jaundice is rarely present. Early temperature, pulse and respiration are normal but later they may show a marked rise. "Symptoms of peritonitis appear when the gall bladder becomes gangrenous and perforates. In the differential diagnosis cholecystitis or cholelithiasis must be con-

sidered. Appendicitis, intestinal obstruction, twisted ovarian cyst and ruptured peptic ulcer must also be considered. Early surgery is the treatment of this condition.

The author presents the case of a 63 year old man who had a smooth pear-sized mass one inch above the umbilicus and to the right of the midline. This was exquisitely tender and rigidity was present. A diagnosis of ruptured ulcer was made and the patient was operated upon. A dark shining gall bladder, twisted at the neck to 360 degrees was removed.

ROBERT E. FLOERZ, M.D.

Operative Cholangiography (La cholangiographie opératoire). P. L. MIRIZZI (Cordoba, Argentine). *Lyon chir* 1948, 43, 383.

Operative cholangiography is accomplished by the injection of an opaque substance, usually lipiodol, into the gall bladder or the common duct. The author, in reviewing the results obtained during 15 years of experience with the method is convinced that the physiopathological state of the biliary tract can be determined with a great deal of certainty by the use of the method described.

Functional dyskinesia of the sphincter of Oddi as well as complete or partial stenosis at the terminal bile duct may be demonstrated by the pencil-shaped elongated and dilated appearance of the common duct. This condition is due to the relative or absolute obstruction at the sphincter.

Various congenital anomalies such as cysts or pseudocysts of the extrahepatic tract, postoperative biliary strictures and anatomic narrowing of the terminal common bile duct from pancreatitis not only can be identified as such but their location can be established as well. The method is especially useful in demonstrating overlooked common duct stones as the cause of postcholecystectomy syndromes.

OSWILL F. CRUMER, M.D.

Hepatic Duct Syndrome (Síndrome del conducto hepático). PABLO L. MIRIZZI. *J internal chir* Brux 1948, 8, 731.

Cholangiography performed at operation has confirmed the hypothesis of a contractile mechanism in the common hepatic duct where its presence had been suspected on anatomic grounds. Histology completes the demonstration by revealing the presence of small annular and corkscrew muscle bundles along the entire canal. This mechanism has a propulsive function in the excretion of bile with a phase of dilatation (diastole) and one of contraction (systole). It has also a protective role, the effect of which is clearly shown not only in the normal biliary passages but also in the dilated choledochus which in its terminal portion impedes more or less the free entrance of bile into the duodenum. Experimental studies and biliary pathology provide valid confirmatory evidence of the protective role played by the hepatic duct system and this protective function justifies the performance of choledochoduodenostomy in cases of partial or complete obstruction of

a permanent nature which would inevitably lead to the icteric syndrome cholangitis and hepatic insufficiency.

The hepatic duct syndrome which is characterized by stasis in the hepatic system is the result of a functional disturbance and of anatomic factors. The functional disturbance consists of a spastic condition of the hepatic duct. The anatomic factors may be a local scar, an abnormal vessel, a displaced Hartmann pouch, a calculus at the entrance of the gall bladder or an obstruction at the junction of the cystic and common bile ducts. A calculus is the most frequent causal factor.

The syndrome simulates the icteric picture of calculus in the common bile duct but the jaundice usually disappears spontaneously or after passage of duodenal tube. In exceptional cases it persists until operation.

Clinical evidence cholangiography bacteriology and pathologic anatomy confirm the existence of a hepatic duct syndrome due to cholangitis without calculus. The facts observed support the pathogenic concept of a descending infection. The first manifestations of which are limited to the hepatic duct system. The same data suggest that certain painful sequelae of operations for cholelithiasis have their origin in unrecognized functional or anatomic factors connected with the hepatic duct mechanism.

During a laparotomy the surgeon should determine the functional and morphologic condition of the hepatic duct system in an attempt to reduce as far as possible the incidence of the painful sequelae of cholecystectomy. This can be done only by cholangiography during the operation.

RICHARD KENT, 31 D

Strictures of the Common Duct. WARREN H. C. JR., JOHN T. REYNOLDS, and CARL E. BREYER, JR. *J. Surg.* 94B, 533

Operative trauma is the most common cause of common duct stricture. Sixty-five per cent of this series of 49 cases of stricture could be directly attributed to operative trauma.

The operative mishaps responsible for the trauma are excision of part of the common duct while it is under tension by traction on the gall bladder; ligation of all or part of the duct while ligating a bleeding vessel; damage to the duct during gastrectomy and damage during choledochotomy. Another cause of stricture is obliterative cholangitis which may be caused by a collection of bile overlying the common duct, a small abscess adjacent to the duct, large masses of ligated material around the duct or possibly pyelophlebitis. In 10 per cent of this series of cases stricture was caused by a chronic pancreatitis of the diffuse fibrosing type. There are other less common causes.

The authors list 13 measures to avoid operative trauma of the common duct, as follows:

1. Maintain carefulness, and refrain from hurry while dissecting structures near the common duct.

Obtain good exposure of the region about the common duct with a long incision. The incision may

be oblique, transverse or longitudinal, but should be of sufficient length to give adequate exposure.

3. Obtain adequate relaxation with the proper anesthetic. Either is an adequate anesthetic in obtaining this relaxation but cyclopropane and curare are likewise effective.

4. Isolate the junction of the common duct and the cystic duct before ligating the latter structure.

5. Ligate no artery until it is proved that it enters the gall bladder.

6. Ligate the cystic duct and artery separately.

7. Cut no structure until it is identified.

8. Ligate the cystic duct at least one-half inch from the common duct. This distance will protect the common duct and likewise prevent reformation of a bulbous tip.

9. Control hemorrhage by pressure with the index finger of the left hand in the foramen of Winslow against the thumb so the bleeding point can be controlled by compressing the hepatic artery. By gradual release of compression the bleeding point can be identified and caught accurately with an artery forceps.

10. If adhesions are dense around the common duct, start dissection at the fundus of the gall bladder and ligate the duct or ampulla high.

11. Eradicate gall bladder disease early before massive inflammation takes place.

12. Be familiar with the abnormal anatomy as well as the normal. The anatomy of the biliary tract is so varied that we can identify no position of the various structures as normal. Normal can only be considered a composite of those types most commonly observed.

Methods of repair are described, and they vary with the level and extent of the stricture.

Local strictures. In cases in which the hilus of the liver is not involved, repair is performed by simple excision with end-to-end anastomosis. The suture line is supported by a "T" tube inserted at least one-half inch below the anastomosis.

Stricture of the distal end only may be repaired in several ways. Side-to-side anastomosis to the duodenum with the use of a longitudinal incision in the side of the common duct is favored by the authors. Another method is to transplant the end of the common duct into the duodenum.

Stricture of the proximal portion of the duct should be treated, if possible by mobilizing and anastomosing the distal end of the duct. If it can be found to the hilar duct.

Absence of the entire duct is the most difficult and the end results of repair are the poorest. The Roux Y arm of jejunum is superior to anastomosis of the duct to a functional loop of intestine.

The hilar duct, if not visible after dissection, may frequently be located by aspiration. The duct may then be opened by incising along the needle with a bistoury and enlarging the opening by blunt or sharp dissection. The duct may then be anastomosed to the arm of the jejunum over a vitallium tube rubber tube, or catheter inserted up through the arm of

bowel into the hilar duct, the other end brought out through the abdominal wall

The authors recently have devised a new method of anastomosing the defunctioned arm of the jejunum to the hilar duct. It is in essence a jejunal graft which is formed by separating the serosa and muscularis from the mucosa for 2 to 3 cm. at the distal end of the jejunal arm. The flaring end of the bell end of a catheter is cut off and anchored in the mucosal graft with several silk or cotton sutures. The resultant tubular graft of mucosa supported by the truncated cylinder of rubber tubing is inserted with the narrow end into the liver up to the bile duct and anchored with two silk sutures.

The results of 63 operations performed upon 49 patients are summarized. Among 38 patients with a Roux Y type of arm, excellent results were obtained in 78 per cent. In 4 of these the new procedure was used, with good results in 3. Excision of local strictures produced excellent results in 86 per cent. The results with anastomosis from the hilar duct to the duodenum were excellent in 14 per cent, and fair in 18 per cent. Failure occurred in 58 per cent. Miscellaneous repairs were excellent in 60 per cent. Failure occurred in 40 per cent. The overall operative mortality was 6 per cent.

FREDERICK C. HOESEL, M.D.

**Etiology of Acute Pancreatitis.** ROLF LIHM and STEPHEN MADDOCK. *Surgery* 1948 24 593.

Experiments with the production of acute pancreatic inflammation and fat necrosis by tying the pancreatic ducts and stimulating the pancreas have been reported. Stimulation of the pancreas has been produced by (1) feeding (2) acetylcholine and eserine (3) pilocarpine (4) stimulation of the vagus and (5) secretin. In a high percentage of these experiments combining obstruction of the pancreatic ducts and stimulation of the gland acute inflammation of the pancreas and fat necrosis resulted. The most extensive and consistent damage resulted when the animals were fed 3 hours before ligation of the pancreatic ducts.

The different mechanisms that can produce obstruction of pancreatic secretion were discussed. The clinical and experimental evidence was correlated to explain the varying degree of acute pancreatitis seen at operation or at autopsy.

Acute pancreatitis is the result of ductal obstruction in an actively secreting pancreas.

CHARLES BARON, M.D.

### MISCELLANEOUS

**Acute Abdominal Disease in the Aged.** WILLIAM C. BRICK. *Surg. Clin. N. America* 1948, 23 1361.

Eight hundred and eighty two patients over the age of 65 were admitted to the Guthrie Clinic, Sayre, Pennsylvania during a 5 year period, with abdominal complaints. In 81 per cent of these the condition could be classified as acute. The diagnostic problem in elderly people with acute abdominal

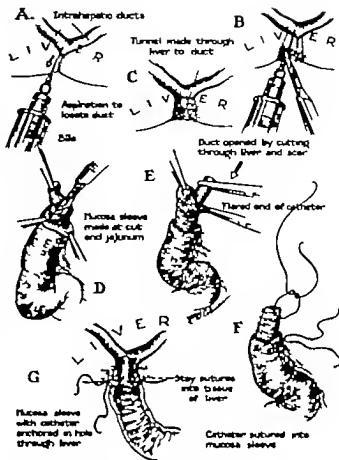


Fig. 1 (Cole, Reynolds, Ireneo). Repair of stricture of common duct by preparation of a mucosal tube and implantation as a graft into the duct opening at the hilus of the liver (modification of Hoeg operation). This procedure is most applicable when no stump of duct remains, and scarred liver tissue must be incised to reach the duct. Depth of the scarred area is exaggerated to better illustrate the method. The mucosal tube is pulled into position and held there by two sutures, each of which is inserted from the outside into the depth of the opening, through the mucosal sleeve, and back through the depth of the opening to the outside where the two ends of each suture are tied together.

disease is usually not the same as that in younger patients because of various factors.

Precious time is lost because families are often convinced that the older members must have aches and pains, and that age itself is such a deterring factor to surgery that it is practically hopeless to ask for surgical aid. As a result older people come into the hospital far later than a similar group of young people.

Cholecystitis with its complications is considered to be the most common acute abdominal disease in the aged, if cases of strangulated hernia are considered separately from those of strangulation from other causes. Over 60 per cent of all abdominal complaints in the aged however fall into these three diagnoses. Next in frequency is diverticulitis and its complications. Appendicitis and perforations, and other complications such as peptic ulcer, encountered so frequently in the young are the least common of the major acute diseases of the aged.

In the present series acute gall-bladder disease was recorded in a patient of 89 years. The pain is usually far more diffuse than in younger individuals and often is centered considerably lower in the abdomen than it is in the young. The pain does not radiate so characteristically to the scapular region and in some patients may radiate directly through to the region of the upper lumbar vertebrae. The tenderness of the abdomen is rarely well defined and localized, and the muscle guarding may be quite diffuse. Fever is often totally absent and the leucocyte count is also completely unreliable. The course of the acute process is possibly more fulminating in the older patient. Rupture of the gall bladder occurs with greater frequency and the patient is less apt to recover spontaneously.

Calculi in the common bile duct are as frequent in the aged as in people in middle life. It is the author's conclusion that patients of advanced age with acute gall-bladder disease should be given a trial of conservative therapy but with much closer and far more frequent observation than younger patients. Unfortunately one must rely almost entirely on clinical sense since laboratory aid is of little consequence. Operation is indicated unless the patient improves perceptibly under conservative treatment.

Subacute obstructions of the colon which are due to carcinomas of the bowel may often be relieved by conservative measures. On the other hand the complete obstructions require a decompressive procedure. In older patients colic is often not as severe as in the young while distention may be tremendous. X-ray interpretation is somewhat more difficult since the ileocecal valve is more frequently incompetent.

The diagnosis of femoral hernia is frequently missed in the admitting room and it is usually not discovered until the patient is in the ward. Other causes of obstruction are more difficult to diagnose. Mesenteric thrombosis was diagnosed in two of three instances in this series and one patient was saved by massive bowel resection. The indications for surgical intervention are complete obstruction of the colon, strangulation obstruction, and irreducible hernia.

The operations were usually carried out under spinal anesthesia and in most instances this seemed to be ideal. Probably in no disease of the aged is the importance of adequate nutritional balance as necessary as in bowel obstructions. Full hydration, and protein and vitamin balance must be maintained parenterally. Repeated studies of the alkali reserve and of the urinary nitrogen excretion are of real value in guiding the therapy. Renal balance is often precarious, and the reserve low in the aged, so that salt retention may be a real problem.

The mortality in 34 cases of strangulated hernia was 11.76 per cent. Patients 88 years of age were operated upon successfully for hernia. The length of time that some of these aged patients have known of their hernias is remarkable. One patient in the author's series had worn a truss for 40 years.

Attempts at reduction by taxis are made first. This is attempted only if the pressure on the sac is not painful and if the patient has not had any sedation for a period of 4 hours. A hernial sac containing bloody fluid will usually be hard and tender and the patient will usually not permit taxis. Placing the patient in a Trendelenburg position for 15 minutes will often facilitate reduction. If this is unsuccessful, an emergency operation is performed. The anesthetic used for such operations consists of a combined anesthetic routine with a field or intersit block supplemented by pentothal or an inhalation medium in very small amounts. In the male with an inguinal hernia the author often removes the testis, thereby saving time and securing a simpler repair. Early ambulation is of benefit.

Colonic diverticulitis and its complications seem to have replaced appendicitis as a frequent cause of acute inflammatory disease of the abdomen in the aged. In all but one of 33 patients in this series the inflammatory lesion was situated in the area of the sigmoid colon. In 1 patient the lesion was in the cecum and had perforated.

The therapy of diverticulitis in the aged, like that in all age groups, is dependent upon the stage of the disease. Only for perforations with a diffuse spreading peritonitis is immediate operation necessary. This consists of exteriorization of the perforated segment, or a proximal colostomy. In patients with localized processes, conservative therapy is usually adequate. At present the author is using sulfacetamide and either sulfadiazine or combinal. As soon as the acute process has subsided, sigmoidoscopic and roentgenographic techniques are employed for further diagnosis.

Only 8.8 per cent of the patients with acute abdominal distress had acute appendicitis. These patients had either gangrene of the appendix or a perforation, due more to the late arrival of the patient at the hospital than to the rapidity of the process. The oldest patient with acute appendicitis was 79 years of age. All patients subjected to operation survived.

Of the author's series of 7 cases of perforated peptic ulcer in patients over the age of 65, operation was performed on 6. All of these patients survived. The age of the oldest patient was 86. The diagnosis of perforated peptic ulcer in the aged is not much different than diagnosis in younger individuals. Operation consisted of a high right paramedian incision, and suture of the perforation with either catgut or cotton with the use of through-and-through sutures. Omentum was tied into the knot. Gastric suction was maintained for 48 hours and ambulation was started on the third day.

In no field of acute surgery is more judgment or tact necessary than in the aged. Many old people feel themselves beyond the age at which surgical intervention is possible, yet there is appreciable preservation of health which surgery can offer to patients within this group.

HAROLD LAUFMAN, M.D.

# GYNECOLOGY

## UTERUS

Contribution to the Study of the Association of Utero-Ovarian Neoplasms in Women with Uterine Fibromyomas (Contributo allo studio delle associazioni neoplastiche utero-ovariche in donne portatrici di fibro-miomi uterini) MARIO OROCHER. *Ann. ostet. ginec.* 1948 70 200.

The author gives an extensive bibliography concerning multiple tumor formation in general and the association of benign with malignant tumors in particular. However, concurrent development of multiple tumors in the genital organs is relatively rare.

In a material consisting of 726 cases of fibromyomas the author encountered 3 cases of sarcoma of the uterus, 16 cases of carcinoma, 27 of serous ovarian cysts, 2 of parovarian cysts, 4 of tubo-ovarian cysts, 2 of ovarian fibromas, 3 of ovarian papillomas, and 1 case of carcinoma of the ovaries. Sarcoma of the uterus was present in 0.45 per cent and carcinoma of the uterus in 2.2 per cent of the entire material.

While some consider a simultaneous occurrence of two different tumors in the genital organs as pure coincidence, others believe that an intimate genetic relation exists between both tumors.

Numerous workers maintain that an ovarian hormone exerts its effect on the uterine muscles. In the presence of ovarian dysfunction such a hormone may represent an important factor in the development of a tumor.

Macroscopic and microscopic study of 3 cases of sarcoma associated with fibroma convinced the author that the malignant degeneration was not a primary process but followed the degeneration of fibrous nodes.

Possibly the coexistence of two different neoplasms may be due to one single factor.

As to the simultaneous occurrence of ovarian tumors and tumors of the uterus, the existence of a functional utero-ovarian synergism suggests that an abnormal stimulus of the fibromyoma may be responsible for the development of an ovarian tumor.

It is evident that a failure to disclose the presence of two different tumors in the same patient may be responsible for improper treatment.

JOSEPH K. NARAT, M.D.

## ADNEXAL AND PERIUTERINE CONDITIONS

Results of Operation for the Restoration of Tubal Patency (I risultati delle operazioni per il ripristino della pervietà tubarica) E. PASCA. *Ann. ostet. ginec.* 1948 70 328.

Occlusion of a tube may develop in its intramural portion, the isthmus, the ampulla, or in the region of the abdominal ostium. The occlusion may be of congenital origin, caused by a defect in the evolution of

Mueller's organ, or by an intrauterine inflammatory process. More frequently a tube becomes occluded following an infection by gonococci, or colon or tubercle bacilli, and compression by a cyst or a neoplasm of an abdominal organ, bridges or adhesions caused by extrinsic processes such as appendicitis may also be the responsible factors.

The following operations have been suggested for restoration of the patency of an occluded tube: ovariopexy, salpingostomy with salpingo-stomatoplasty and resection of the uterine horn and the isthmus portion of the tube followed by implantation of the remaining part of the tube into the uterus.

Of 364 patients operated on for tubal occlusion 202 could be followed up.

In 52 a bilateral tubal resection, bilateral salpingostomy and stomatoplasty were performed. Pregnancy occurred after the operation in 9.6 per cent of this group.

In 110 patients a unilateral tubal resection with salpingostomy and stomatoplasty was performed and the other tube was preserved. In this group gestation followed the operation in 13.3 per cent of the cases.

In 9 cases resection of the tubal angle and implantation of the tubes were performed. The operation was done on one side in 2 patients and on both sides in 8 patients. In 44 per cent of this group pregnancy followed the operation.

Gestation was recorded in 20 per cent of the group of 5 patients in whom ovariopexy had been done.

In 17 or 8.4 per cent of the total group of 202 patients subjected to operation, gestation was recorded, but only in 6 was the gestation carried to full term.

An operative procedure for occlusion of a tube is indicated only if the patient is younger than 35 years, if there is no evidence of inflammatory changes in other parts of the genital tract, if there are no signs of infantilism, and if no disturbance of other organs associated with internal secretion are present.

JOSEPH K. NARAT, M.D.

## EXTERNAL GENITALIA

The Influence of Gonadotropic Hormones on the Biology of the Vagina (Physiologic Bases) (L'influence des hormones gonadales sur la biologie du vagin: bases physiologiques) J. A. SCHOCKAKAT and J. FLEHN. *Gyn. abh., Par.* 1948 47 421.

Histologic and chemical studies of the vaginal epithelium provide valuable information on the action of sexual hormones. They enable the physician to form a correct judgment as to the hormonal equilibrium and by repeated examinations to control the effect of his treatment.



The following procedure should be followed (x) histologic examination of the vaginal epithelium (a) determination of glycogen content by carmalum stain by the Schiller test or by quantitative analysis (3) determination of the pH by colorimetric or electrometric methods (4) examination of the vaginal content either by smear or by aspiration (5) bacteriological studies.

Four types of cells from the epithelium are found. The first of these are so-called "atrophic" cells from the deep layer of epithelium they are small, with large nuclei and basophil cytoplasm. The second are intermediary cells from the spinous layer these are larger oval or fusiform and basophil with intensely staining periphery. The third are superficial cells these are large squamous, polygonal, mostly with acidophil protoplasm and pyknotic nucleus. The fourth are acidophil cells without nucleus. The proportion of each of these types of cells varies in a characteristic way during the monthly cycle.

The authors describe in detail the histology and chemistry of the vaginal epithelium during fetal life in the newborn in the prepubertal period in the adult, in pregnancy in the puerperium and in the menopause. The production of estrogen determines the growth and differentiation of the epithelium in puberty and its involution at the climacteric.

The production of progesterone causes desquamation of the superficial layers, and other typical changes. It is, however difficult to determine the time of ovulation by a study of vaginal smears.

The acid reaction of the vagina is caused by endocrine factors and not by the Doederlein bacillus. However experiments carried out during the prepubertal period show that the Doederlein bacillus produces considerable increase of acid ty

WEINER M. SOLMITS, M.D.

**The Influence of Gonadotropic Hormones on the Biology of the Vagina. Pathology and Therapy** (L'influence des hormones génitales sur la biologie de vagin, pathologie et thérapeutique) II. P. WATTEVILLE and L. DAWON *Gyn. et Obst. Par.* 915, 47 437

An insufficient or excessive output of sexual hormones changes the histologic structure of the vagina its glycogen content, its pH, and its bacterial flora in typical way. For this reason various affections of the vagina can be treated successfully with gonadotropic hormones.

Low estrogen output causes atrophy of the epithelium and a decrease of glycogen content. The consequent diminution of acidity favors the development of a pathogenic flora. Thus, atrophic vaginitis and in the most severe cases, kraurosis may develop. The vagina becomes more susceptible to mechanical, chemical or infectious lesions.

Estrogen treatment is indicated not only in atrophic vaginitis of adults but also in vaginitis of the prepubertal period and in vaginal hypoplasia.

On the other hand an abnormal increase of estrogen may cause hyperemia, leucorrhea and an in-

crease of acidity and may lead to the development of mycoses. Abnormally high acidity may also be a cause of sterility.

Increased progesterone production, as in pregnancy causes venous hyperemia softening of the mucosa and transudation.

The administration of testosterone causes atrophy of the vaginal epithelium with a decrease in glycogen and acidity. It is indicated in conditions of abnormally high estrogen production.

WEINER M. SOLMITS, M.D.

**Fibromyomas of the Vagina** (I fibromiomi della vagina) LIVIO CE VELLATI. *A. N. Ost. G.* 915, 70 35

Two cases of fibromyomas of the vagina in middle-aged married women are reported. One patient had never been pregnant, the other had had 3 pregnancies and 1 normal childbirth. In the nullipara, the growth was silent and was discovered accidentally in the other woman there was some metrorrhagic bleeding which brought her to the gynecologist. In both of these patients the vaginal new growths were associated with a fibromatous uterus and the vaginal tumor was at first thought to be a subligamentous cervical fibroid.

In both instances a total hysterectomy was done, with removal of that part of the vaginal wall to which the tumor was adherent. Histologic examination then disclosed the fact that the pedicle took origin from the smooth vaginal musculature—from the right side of the vaginal fornix in one patient, and from the left in the other one. The histologic study of the tumors themselves showed that they were fibromas with a vast predominance of the fibrous elements, especially at a distance from the insertion of the pedicle. There was no evidence anywhere of epithelial glands, or centers of hyperplasia of muscular tissue which would support the theory of their origin from embryonic rests or from remnants of the Wolffian duct.

Despite the lack of evidence of dysembryogenesis, the author believes that these tumors arose from a disordered embryogenesis with remnants of the embryonic elements persisting until the ages of 40 and 45 years, respectively. At these ages there arose a proliferative morbidogenic stimulus which, in the light of modern concepts, is envisaged as an augmentation in the production of folliculin, this augmentation taking the character of increase in quantity and also of increased duration (dysfolliculinism).

JOHN W. BRENNAN M.D.

## MISCELLANEOUS

**Röntgen Diagnosis to Gynecology and Obstetrics** (Roentgen Diagnosis in Gynecology and Obstetrics. La radiodiagnostica en gynecologie et obstétrique. La radiodiagnostica en gynecologie) R. KELLER. *Gyn. et Obst. Par.* 915, 47 430.

The author gives an exhaustive report on the use of hysterosalpingography for diagnostic purposes.

The capacity of the normal uterine cavity does not surpass 2 to 3 c.c. but may be much greater in pathologic cases. It is important to use the manometer for measuring the tonus of the uterine musculature which is normally between 4 and 6 cm. Hg in the week following menstruation. In uterine hypotony it may drop to 2 or 3 cm and in spastic dysmenorrhea it may be elevated up to 10 or 15 cm. In order to fill the tubes with contrast material a pressure of at least 10 cm must be applied but it should never surpass 30 cm. Hg.

As to the different substances in use, the author believes that perabrodil initiated by Kjellberg of Sweden is superior to lipiodol or thorium salts. This watery solution is very liquid and passes through even very narrow tubes furthermore it has the advantage of mixing freely with liquid material as in hydrosalpinx or ovarian cysts. It can be used without risk in metrorrhagia, and as it diffuses readily to the circulation no danger of embolism is present. It is eliminated by the kidneys in from 0.5 to 2 hours. In contrast to this fast elimination of an aqueous solution lipiodol that has entered the free peritoneal cavity by way of the tubes disappears usually after 6 to 8 weeks however in fixed pockets and recesses it may stay for months or years.

The risk of hysterosalpingography is minimal if the procedure is performed technically correctly. Local reactions ("oil peritonitis") are extremely rare and seem to occur only when the amount of injected lipiodol is unduly large. In such cases local peritoneal irritation may give rise to adhesions. The only two contraindications are acute inflammatory processes and the possibility of pregnancy. The best time to perform the examination is between 5 and 7 days after menstruation.

The study of the evacuation of the contrast material by means of a series of films is important for the diagnosis of hypertony or hypotony of the uterus.

The clinical application of hysterosalpingography is manifold and helpful for the diagnosis of the majority of pathologic processes in the genital tract. Malformations and infantilism of the uterus, polyps and submucous tumors of benign or malignant character, retention of placental tissue and other pathologic conditions can be diagnosed with less risk and greater exactitude than by any other clinical method. In metrorrhagia of hormonal or other origin curettage is the method of choice but hysterosalpingography often gives valuable additional information if applied by the "thin layer" method which produces a well differentiated relief of the mucous surface. The same is true in pathology of the tube and ovary. Various types of salpingitis, hydrosalpinx, stenosis and occlusion of inflammatory or mechanic origin can be differentiated by this method.

However, the study of sterility has benefited from hysterosalpingography more than that of any other field in gynecology. It is no longer admissible to start the treatment of sterility without the informa-

tion given by this method. Not only the condition and permeability of the tubes but a number of other pathologic processes like malformations, uterine deviations, and cervical irritations may be the cause of sterility and can be discovered roentgenologically.

Finally pelvic tumors outside of the uterine cavity can be visualized by a combination of hysterosalpingography with pneumoperitoneum.

WERNER M. SOLMITZ, M.D.

**Amenorrhea Among the Inmates of German Concentration Camps in 1944 and 1945** (*L'amenorrea nelle internate nei campi di concentramento tedeschi, 1944-45*) EMIL BERNHARD, *Ann. ostet. gin.* 1948 70 271

Practically all female inmates of the concentration camp in Auschwitz were suffering from amenorrhea which lasted from 3 to 4 months.

The author ascribes this phenomenon to an inhibition of the neuroendocrine centers.

In instances in which the amenorrhea lasted more than 3 or 4 months other factors had to be considered. These cases could be divided into two groups: (1) the psychic, in which the causes were anguish, confusion and uncertainty and (2) the physical in which the causes were mainly inanition, hypovitaminosis and overwork.

JOSEPH L. NARAT, M.D.

**The Cytology of Neoplasms of the Female Genital Apparatus, Before and After Radium Treatment, Studied by the Apposition Method** (*La citologia dei neoplasmi dell'apparato genitale femminile, prima e dopo trattamento radium studiato con il metodo della apposizione*) MARIO BIANCHI, *Tumori, Milano* 1948 34 82

The impetus given to the interpretation and evaluation of the radiation changes to be observed in the normal and abnormal cells of the female genital tract by recent studies, particularly those of Ruth M. Graham (*Surg. Gyn. Obst.* 1947 84 153 and 166) makes further examination of the subject seem desirable. The author's material included 45 cases of neoplasms of the female genitalia, consisting of 25 epitheliomas of the portio, 10 of the undifferentiated type, 3 spinocellular and 8 basocellular, 4 were unclassified carcinomas. There were also 3 adenocarcinomas of the cervical canal and 13 of the uterine corpus, 2 ovarian cancers, 1 chorioepithelioma and 1 primitive carcinoma of the vagina. In addition to the usual vaginal smear, serial biopsy and histologic methods, the author employed the method of apposition. This consisted in pressing the glass microscopic slide lightly against the area to be examined. When this slide is pulled away it brings away with it both neoplastic and normal cells and this specimen is then fixed with methyl alcohol, stained by the Giemsa method and examined just as is done in blood smears. The apposition method was also extended to the study of such normal tissues as the ovary, placenta and other tissues of human preg-

nancy and to the noninfiltrative type of chorionic mole.

The author does not state that his findings were essentially different from those reported by Graham but his purpose in making the study was not so much the solving of the question of prognosis and evaluating the efficacy of irradiation as apposed to surgery as the determining as to whether any one characteristic of the cells or any combination of characteristics of the single cell—irradiated or not—would establish a diagnosis between the normal and neoplastic cell in this region, or between the different types of neoplastic cell.

From the results of these studies it is concluded that no single characteristic of the cells and no combination of characteristics of a single cell in this material will establish a certain distinction between the neoplastic and the normal cell. It is true that a general consideration of all the characteristics of the different types will usually enable a distinction between the cell of carcinoma of the female genital tract and the normal cells of the same region, or between the neoplastic cell and the cell of other morbid conditions not neoplastic in nature. Even the individual response of these different types of cells to radiation treatment does not render the distinction more reliable. In general by the general consideration of all the characteristics of all the cells in a single patient studied, a distinction can be made between cancer and normal tissues or non-neoplastic morbid tissues however not even the response to irradiation will distinguish reliably the different types of carcinoma such as the epidermoid type and the adenocarcinoma. In the case of the chorionic cells not even the distinction between the neoplastic and non neoplastic forms can be reliably made. In other words the information to be gathered from a study of the cytology of the female genital tract is purely orientative in character and in such a sense it may be practically utilized.

The practical utility of the method resides in the possibility of its application for following the general effects of the irradiation treatment, with its succession of degenerative and destructive changes in the nucleus and protoplasm day after day by a simple, innocuous and rapid method of examination until that time when all neoplastic elements have disappeared. In this sense the asposition method is superior in most respects to biopsy.

JOHN W. BREDEN, M.D.

**Peridural Anesthesia in Gynecology Technique and Experience.** (Periduralanästhesie in der Gynaekologie. Technik und Erfahrungen.) GUZIKER SCHMIDT. *Gewürk & Frauenh.*, 1918, 8:549.

A 2/1000 solution of pantocain in water is injected, with the precautions peculiar to this method and the precautions common to ordinary lumbar anesthesia into the space between the ligamentum flavum and the spinal dura, that is, the peridural space. The amount injected is usually 45 c.c., and the lumbar interspace chosen for the needle puncture

is usually the third or fourth. Injection through the fourth interspace will usually be sufficient for perineal procedures, while the third lumbar interspace is usually utilized for laparotomies.

In the presence of technical difficulties, such as the accidental perforation of the dura in the third interspace, or for the removal of very large tumors, the second interspace may be used. The anesthetic solution is usually injected in 10 c.c. fractions at 10 minute intervals and in 15 minutes after the last injection the anesthesia is usually advanced to the point where the operation can be started. The anesthesia as a rule lasts from 3 to 5 hours.

The advantages of this method of anesthesia are its long duration (from 3 to 5 hours) which enables several patients to be prepared at one time, enables the operation to be delayed while some emergency operation is done, or the operation itself may be extended if conditions demand it. The manual relaxation of the abdominal muscles together with the almost complete maintenance of intestinal tone renders the gynecological abdominal field more approachable and the manipulations less traumatizing. Following the operation the patient may be placed in any position in bed and does not need someone in constant attendance. The anesthetic is not followed by headaches or vomiting. Bowel and kidney functions continue undisturbed and respiratory secretions have not been observed.

The only contraindications to peridural lumbar anesthesia are local inflammatory processes and extreme deformity of the lumbar vertebral column (the ordinary grades of scoliosis are not contraindications) diffuse peritonitis, nephritis, flux, or other conditions tending markedly toward circulatory collapse.

Since the author finds that this method of anesthesia has all the advantages of intradural lumbar anesthesia without its disadvantages, and since the method is safe and easy of application, peridural lumbar anesthesia is warmly recommended for extensive use in the smaller gynecological institutions where personnel is scarce and convenience is at a premium.

JOHN W. BREDEN, M.D.

**Cystitis of the Trigone in Women** (La cystite du trigone chez la femme) GUSTAV T. HENNING. *Abh. gyn. acad.*, 1918, 23: Supp. 2.

The author reviews the literature on cystitis of the trigone in women, following which he reports the results of his clinical experience in 300 cases. His anatomical material consisted of 68 biopsy specimens from the vesical trigone, 115 from the mucous membrane of the cervix, and also 83 postmortem specimens from the vesical trigone.

Contrary to existing theories, an analysis of the clinical results showed that hyperemia of the trigone of gynecological origin does not produce any disturbance of urination even in patients with longstanding hyperemia, and it is believed that the trigonal hyperemia caused by pelvic disease does not give rise to trigonitis.

It was ascertained that the true incidence of polypoid protuberances at the neck of the bladder was 24 per cent, which indicates that the presence of these protuberances bears no relation to trigonal hyperemia or urethritis. The author emphasizes the fact that there has been no evidence in the present material which would indicate that the polypoid protuberances give rise to urinary symptoms. Every third woman suffered from chronic urethritis which had no relation to trigonitis or polyps at the neck of the bladder. A generalized hyperemia of the urethral mucosa which seemed to be a part of the urethrotigonitis was observed half as frequently. This form of the condition does not give rise to constrictures of the bladder neck. The author states that while pelvic disease and genital activity cause bladder irritability there is no clinical evidence that it may cause trigonitis nor is increased urinary infection noted in these cases.

Histologic examination revealed a great increase in subepithelial lymph follicles in the vesical trigone and it is believed that their presence is increased in patients with trigonitis. The author has observed also a squamous metaplasia of the transitional epithelium of the trigone showing a marked resemblance to the epithelium of the vaginal mucosa. Experiments with estrogen indicate that the trigone may present the same cyclic phases as those occurring in the vaginal epithelium. Cystoscopic examinations of iodine-stained epithelium of the trigone show the presence of glycogen in these squamous cells of the trigone and there seems to be a relation between the extension of the metaplasia and the pattern of the trigonal hyperemia. In view of the rich flora of bacteria in the urethra, the author believes that this same pavement epithelium of the trigone is particularly liable to infectious effects.

In conclusion the author states that in his opinion trigonitis is the pathologic reaction to infectious and hormonal influences to which the trigone is submitted. Urinary symptoms other than those caused by urethritis seem to be explained by trigonitis as such, or by a state of irritation in the adjacent internal sphincter the latter developing as a result of the trigonitis. JAMES C. MACMILLAN M.D.

**Bladder and Ureteral Malformation in Genital Prolapse** (Les déformations vésicales et urétrales dans les prolapsus génitaux) G. GUNDELINER and H. CAVALIER. *Rev. fr. gyn. obst.* 1945 43 93.

The authors present a very interesting and practical article concerning the changes in position of the urethra, bladder and ureters in the various degrees of prolapse with 9 roentgenograms and diagrams. They have carried out complete urological studies on 60 patients with genital prolapse and have evaluated their findings.

They found that the changes in position of the urethra, bladder and ureters depended on whether there was a primary prolapse of the uterus with secondary vaginal inversion or a primary vaginal prolapse with secondary progressive elongation of the

cervix. They found two types of cystoceles: a type in which the cystocele was developed at the expense of the preureteric and interureteric zones by their gradual attenuation and a second type in which the cystocele was formed by the floor of the bladder, the cervix, and the ureters swinging around the lower border of the symphysis. In this second type particularly, all of the organs rotated below the symphysis. The meatus descended a little, the bladder more, the ureteral orifices and the terminal portions of the ureters likewise, and the uterus descended to the greatest extent. The greater the descent, the more variation in the site of the urethra, which had a greater and greater tendency to become vertical. In introducing a cystoscope it had to be passed downward from above.

Cystograms of the anterior and lateral views showed the shadow of the bladder to be in the form of a pear with the broad side uppermost and completely exteriorized below the symphysis when the prolapse was exteriorized. If the prolapse was reduced, cystography often showed a very large bladder rounded like a small balloon. Sometimes, at the level of the lower pole of the bladder, irregularities could be seen resulting from folds of the bladder wall.

The cystoscope showed important changes in the base of the bladder. It was seldom easy and often very difficult to visualize the base of the bladder. If the prolapse was protruding it was usually impossible to find the ureteral orifices. The ureters often resembled the mouth of a gland and it was only after injections of indigocarmine that blue dye could be seen coming from the invisible part of the base of the bladder. Upon reduction of the prolapse the ureteral orifices became plainly visible.

The ureters were generally elongated and completely exteriorized beyond the pelvis in roentgenograms made with ureteral sounds in place. Although it was often difficult to catheterize when the prolapse was reduced, the ureters were very easily entered at the moment when the prolapse was produced as the patient strained.

Urosectan was employed in every case to evaluate the degree of ureteral and kidney pelvis dilatation and at the same time to study the renal function in the aged women. In contrast to most autopsy reports the authors found no case of ureteral constriction with dilatation above. Bilateral hydronephrosis was only present in 1 woman of 72 years with a total prolapse, while another patient had a slight hydronephrosis on the right side due to angulation of the lumbar ureter with renal ptosis.

In all 60 cases observed the renal function was normal.

These studies suggest certain operative dangers in the treatment of prolapse. There is danger of injury to the urethra at the time the anterior vaginal wall is opened, danger of injury to the bladder when the bladder is freed from the cervix, and, especially, there is danger of injury to the ureters when the lateral attachments of the bladder are freed.

CHAS. W. MUCKLE M.D.

# OBSTETRICS

## PREGNANCY AND ITS COMPLICATIONS

Death Following an Autotransfusion (Todesfall nach Refusion) E. E. MANUELIDIS. *Geburts & Frauenk.*, 948, 2, 42

The author reports the case of a death which followed an autotransfusion. The patient had suffered a massive intraperitoneal hemorrhage from the rupture of an ectopic pregnancy. The blood was recovered from the peritoneal cavity mixed with sodium citrate and Ringer's solution, filtered, and administered by venoclysis. The patient soon became jaundiced, anuric, and dyspneic. Stupor and death with anemia followed. The complete autopsy protocol revealed only a tubular blockage by acid hematin as the cause of death.

Only 3 other similar cases have been found in the literature, according to Manuelidis. He suggests that in some cases the blood leaving its normal intravascular habitat, may undergo degenerative changes which release hemoglobin. From a clinical viewpoint, there is no rapid way of determining which bloods have been so changed. It is implied that, although this accident is rare autotransfusion is not a procedure of choice.

WILLIAM C. BECK, M.D.

## LABOR AND ITS COMPLICATIONS

Cesarean Section at the Boston City Hospital, from 1934 to 1944. DANIEL J. McSWINEY and ARTHUR J. HAMMETT. *J. England J. M.* 1948, 239, 54.

Hemorrhage and sepsis are the most common causes of mortality following cesarean section. Whole blood given early, rapidly and copiously is the only way to combat hemorrhage. Too often, transfusions are given too late, too slowly and in too small amounts. Cesarean section must not be done in the presence of shock. Shock must first be treated as expeditiously as possible. One must be sure there is no chance for secondary hemorrhage either from uterine atony or from improper hemostasis before the abdomen is closed.

Cesarean section has a distinct place in the treatment of toxemia and does not add to the risk particularly if it is done under local or sodium pentothal anesthesia.

There is no limit to the number of cesarean sections that a patient may undergo provided sufficient attention is given to the uterine scar both before and at operation.

The danger in cesarean section after rupture of the membranes and prolonged labor is sepsis. Therefore every patient in whom cesarean section is probable when given a test of labor should receive sulphonamides and penicillin prophylactically after the first 12 hours. In the frankly infected cases the extraperitoneal operation should be done.

Cesarean section in women with heart disease offers no advantage over delivery through the pelvis and should not be done unless there is some other indication.

Anesthesia for cesarean section must be administered by a trained anesthetist, especially if spinal anesthesia is used.

With proper attention to these suggestions the mortality for cesarean section should be kept below 1 per cent.

CHARLES BABCOX, M.D.

## PURPERIUM AND ITS COMPLICATIONS

Secondary Effects of Penicillin During Pregnancy and the Puerperium (Efectos secundarios de la penicilina durante el embarazo y el puerperio) G. COLMERO-LAROTTE. *Rev. esp. obst. ginec.*, 948, 5, 141.

On administering various forms and quantities of penicillin to the pregnant patient for different causes, the following secondary effects were recorded:

1. Of 11 patients in the first trimester 4 experienced light pains (1 with a slight hemorrhage), 6 showed no disturbance and 1 aborted. Eight of these patients had gonorrhea, 3 had prostatic infections and the patient who aborted was hectic.

2. Of 5 patients in the second half of gestation, 4 experienced no effects and 1 patient had slight pains.

3. Of 10 patients treated during delivery and the puerperium 4 had no untoward results, 3 experienced major hemorrhage in the lochia, 3 had a diminished milk secretion and 1 patient had metrorrhagia. These patients were treated for infections of the genital organs, puerperal parametritis, and mastitis.

From the study it is believed that penicillin therapy is capable of producing uterine contraction in some instances, and this possibility must be reckoned with to avoid abortion. Furthermore, it is stated that the lochia is increased and the secretion of milk is diminished by the administration of penicillin.

STEPHEN A. ZIEGLER, M.D.

## NEWBORN

Diaphragmatic Hernia as a Problem of the Obstetrician. Diaphragmatische Hernie als Problem des Geburtshelfers. Ueber die Zwerchfellbrüche bei Neugeborenen. OLAVI KORHONEN. *Ann. Chir. gyn. fenn.*, 948, 37, 93.

The author reviews the embryology, classification, clinical picture, diagnosis, and treatment of congenital diaphragmatic hernia. When there is a diaphragmatic defect which permits the abdominal contents to enter the thorax, the condition is known as a false diaphragmatic hernia when there is merely



Fig. 1 (Ginglinger) Fetography by amniography. a, Fetus, third month stomach and small intestine. b Fetus, fourth month lungs, small intestine, stomach. c, Fetus,

fourth to fifth month stomach, small intestine, lungs. d Fetus, fifth to sixth month cecum and colon (thorotrast and umbrothor)

a weak spot with sac formation a true diaphragmatic hernia is present. Among 1,363 newborn infants who were examined after death during the years from 1938 to 1947, 22 had false diaphragmatic hernias often with other anomalies. All of the infants were stillborn or died soon after delivery.

One should consider such a diagnosis in cyanosis of the newborn. Roentgenologic confirmation is necessary for the establishment of a definite diagnosis but with the heart clinically displaced to the right, tympanic percussion note and faint breath sounds over the left hemithorax, sucking in of the lower thorax and epigastrium with inspiration and hepatomegaly diaphragmatic hernia must be considered.

The author suggests that if the diagnosis can be made early and the general condition of the child permits operative correction may be feasible in some instances.

WARREN R. LANG, M.D.

#### MISCELLANEOUS

##### Radiodiagnosis in Gynecology and Obstetrics.

Radiodiagnosis in Obstetrics (Le radiodiagnostic en gynécologie et en obstétrique. Le radiodiagnostic en obstétrique.) A. GINGLINGER. *Gyn. obs.*, Par 1948, 47: 481.

The author presents a comprehensive report of the use of roentgenography in normal and pathologic pregnancy.

Except in cases of excessive obesity the fetus can be recognized in the roentgenogram with certainty in the sixteenth week of pregnancy although, in favorable cases, roentgenologic diagnosis is possible as early as the twelfth week. Roentgenography following the injection of lipiodol in the uterine cavity gives a characteristic picture as early as the sixth week of pregnancy. Although the risk of abortion seems to be small, hysterography should be performed only in cases in which interruption is in

dicated. The author believes that roentgenography during the first half of pregnancy is of little practical interest in view of the dependability of the hologic tests.

During the second half of pregnancy roentgenography has been used to determine the presentation, position, attitude, age, and sex of the fetus; however, because of individual variability, determination of the age according to the development of the ossification centers around the knee is not free of error. Another method of the determination of age is measurement of the fronto-occipital diameter. Some authors have attempted to determine the sex of the fetus by roentgenography of the fetal pelvis shortly before term.

Whereas all these methods are of little practical value, roentgenography is more helpful for the diagnosis of multiple pregnancy especially in cases of polyhydramnios although errors of diagnosis may occur even with the most modern equipment.

Furthermore, it is believed that fetal malformations and monsters can be recognized in the roentgenogram as well as other defects such as hydrocephalus, anencephalus and spina bifida. Death of the fetus can be diagnosed by abnormal flexion, lordosis, gibbus of the vertebral column or abnormal position of the extremities caused by hypotony of the skeletal muscles. Another sign of death is the aureola around the skull due to separation of the skin and adipose tissue from the cranial bones.

The differential diagnosis of tumor and pregnancy or the coexistence of both can be seen in the roentgenogram as well as ectopic pregnancy in its later stages. In certain cases of hydatid mole, hysterography after the injection of lipiodol is an aid in establishing the diagnosis.

The injection of opaque substances in the amniotic sac is without danger and permits visualization of the placenta and the soft parts of the fetus, es-

pedially the lungs and the gastrointestinal tract. The injected contrast substance is rapidly eliminated by the maternal kidneys.

The injection of opaque substances in the maternal circulation as a means of visualizing the placenta is still in the stage of animal experiment. In cases of low insertion of the placenta or suspected placenta previa, direct roentgenography of the uterus after filling the bladder either with air or with contrast substances will confirm the diagnosis. The author states that roentgenographic study has increased considerably our knowledge of the mechanism of birth, and of descensus and expulsion in the different presentations. The injection of barium sulfate in the umbilical vein immediately after delivery permitted study of the mechanism of separation of the placenta.

In conclusion the author states that great progress has been made in pelvimetry. Several methods of measuring the obstetrical diameters directly by roentgenography are described. Stereoscopic radiography has become very valuable in the diagnosis of dystocia of bony origin and enables the obstetrician to decide early between cesarean section and forceps delivery. WERNER M. SCHMIDT, M.D.

**Comparative Physiology of Fertilization and Its Application to the Study of Sterility in Man**  
(Physiologie comparée de la fécondation et applications. Étude de la stérilité humaine.) R. MORICARD  
*Gyn. obs. Par.* 248, 47-4

This article is a brief summary of our knowledge concerning the physiology of fertilization, especially the influence of chemical substances and hormones on maturation and fertilization.

The oocytes of plants and certain lower animals (echinoderms) produce a substance "fertilizin," which attracts specifically the spermatozoa. In echinoderms, frog and rabbit proliferation of the nonimpregnated ovum can be produced with testicle extract or certain chemical compounds.

Experiments in mammals (dog, rat, guinea pig, and monkey) prove that the pituitary is necessary for normal spermatogenesis. In hypophysectomized animals the injection of pituitary gonadotropin hormone restores normal spermatogenesis, whereas chorionic gonadotropin fails to re-establish maturation. Vitamins E and A seem to play a role in spermatogenesis.

A certain concentration of spermatocytes in the semen is necessary to secure fertilization. In the

rabbit, at least 1,000,000 spermatozoa per cubic centimeter are required for constant fecundation. If the amount is less than 10,000 per cubic centimeter sterility occurs. In addition to normal spermatogenesis normal secretion of the prostate is necessary for fertilization. Among the different substances of prostatic secretion hyaluronidase seems particularly important. In the rabbit, the addition of hyaluronidase to diluted semen permits fecundation. In mammals fertilization occurs in the tube generally; the nature of the tropism causing the ascent of the spermatozoa is unknown.

Zondek showed in 1926 that it is possible to provoke follicle development in the prepubertal mouse by implantation of pituitary tissue. In female rats, hypophysectomy and the injection of gonadotropin produce analogous effects on maturation of the oocytes, as was described for the male. Rupture of the follicle is caused by the influence of gonadotropin, the contraction of the smooth muscle of the follicle wall under the possible influence of estrogen and a proteolytic ferment which permits the opening of the follicle.

Little is known about the penetration of the spermatozoon into the ovum in spite of many experiments in vivo after artificial ovulation, or in vitro. The author succeeded in cinematographing the entering of rabbit spermatozoa in the cluster of periovular cells in vitro but failed to observe the passage through the vitelline membrane.

Our knowledge of the physiology and pathology of fertilization in man is quite limited. Penetration of the sperm cell in the ovum has never been observed either in vivo or in vitro. Normal human semen contains 100,000 cells per cubic millimeter, 80 per cent of which are movable. Less than 60,000 cells per cubic millimeter are considered as presenting the condition of oligospermia. In pathologic cases the cells may be immovable, the time for the reduction of methylene blue may be prolonged, and the amount of hyaluronidase diminished.

Various conditions may prevent the ascent of the spermatozoa: changes of the vaginal pH which cause rapid loss of motion, increased viscosity of the cervical mucus, endometritis, and occlusion of the tubes.

In conclusion the author discusses very briefly the treatment of human sterility by artificial insemination, hormonal therapy and the administration of hyaluronidase.

WERNER M. SCHMIDT, M.D.

# GENITOURINARY SURGERY

## ADRENAL, KIDNEY AND URETER

**Renal Trauma.** KENNETH M. LYNCH, Jr. *J. Urol.*  
Balt. 1948, 60, 377

During a 7 year period 23 patients with renal injury were admitted to the Charlotte Memorial Hospital Charlotte North Carolina. Operation was performed in 30 per cent of the cases and there were 3 deaths in the series.

Pain was the presenting symptom in 83 per cent of the cases and the severity of the pain was more or less correlated directly with the severity of the injury. All of the patients presented hematuria. About three fourths of the group were found to have tenderness in the flank. Rigidity on the affected side was found in 60 per cent of those having ruptures and in 22 per cent of those with contusions. One-third of the patients having renal rupture presented a palpable mass in the flank. Shock was present in 33 per cent of the patients with rupture and in 33 per cent of those with contusion.

Intravenous urography was performed on 15 patients. There was no function from the injured side in 2 cases, poor filling was observed in 7 and good filling in 6. Seven patients were operated on—nephrectomy being done in 4 cases, drainage in 2 and repair and drainage in 1 case.

The author states that the ruptured kidney which is not explored is subject to a number of sequelae, such as secondary hemorrhage, urinary extravasation, infection, hydronephrosis, stone formation and calcified cysts of the kidney. He believes that all cases of renal rupture as established by flat film excretory urography or retrograde pyelography should be subjected to exploration and emphasizes that this should be done early.

JOSEPH E. MAURER, M.D.

**Immediate and Remote Descending Pyelography in Renal Contusion** (La pielografia discendente nel decorso immediato e negli esiti tardivi delle contusioni renali). GIORGIO DI MAIO. *Arch. Ital. urol.* 1948, 22, 301

Observations on 16 cases of contusion of the kidneys proved to the author the diagnostic value of descending pyelography. Only in rare cases was it necessary to resort to ascending pyelography.

The employment of the method as soon as possible after the injury offers suggestions as to the choice of surgical procedure and the treatment of complications. In the great majority of cases the early employment of descending pyelography avoids the necessity of using chromocystoscopy or cystoscopy with catheterization of the ureters. A repetition of the method at certain intervals offers the opportunity of studying the anatomic and functional evolution of the arteropyelorenal lesion.

The early employment of the method is not connected with any danger. It discloses the existence

of any of malformations or other pre-existing lesions such as lithiasis or hydronephrosis.

The limited number of observations does not allow any definite conclusions as to the effect of contusion of the kidney on the rapidity of appearance of the contrast medium, intensity and duration of the secretion. In many instances the contrast medium appeared within 3 to 5 minutes after the intravenous injection in the presence of a grave renal contusion. In cases of medium gravity the elimination of the dye was abnormally prolonged.

Renal ptosis, perireteropyelonephritis, pyelocalculosis and other conditions may be disclosed by pyelography at certain intervals after the injury and thus may contribute to the employment of conservative surgical measures.

In many instances the roentgenologic exploration obviates the necessity of a surgical exploration.

JOSEPH K. NARAT, M.D.

**Pyelitis Glandularis.** GEORGE L. TORRESA, Jr. *J. Urol.* Balt. 1948, 60, 393.

The fourth case of pyelitis glandularis is reported. It was discovered in a 46 year old negro who underwent nephrectomy for a nonfunctioning kidney which contained a staghorn calculus. Histologic study revealed the presence of mucous glands in the renal pelvis, similar to those in the colon. Goblet cells actively secreting mucin were present. Lymphoid follicles were numerous.

In all 3 previously reported cases calculi were present. The question is raised as to whether this condition is a metaplasia or whether pre-existing fetal cell rests have been stirred to activity. Metaplasia can be seen in the same microscopic section in some cases of cystitis glandularis showing the change from transitional to columnar and then to true glandular epithelium. Squamous anaplasia may also be present. Many workers believe that chronic irritation is the cause of the metaplasia.

The cell rest theory also has appreciable evidence in its favor for the ureteric bud arises from the cloaca. This common origin of the epithelium of the urinary tract and the bowel makes very real the possibility of a dormant fetal rest being stirred into activity by chronic irritation.

The author considers the danger of this glandular lesion undergoing malignant degeneration whether it be in the kidney, ureter or bladder.

JOSEPH E. MAURER, M.D.

**Renal Decapsulation in Mercury Nephrosis.** C. W. VERMEULEN and C. R. SWEAD. *J. Urol.*, Balt. 1948, 60, 216

The present study was made in order to determine the value of renal decapsulation in anuria and uremia due to experimentally induced mercurial poisoning.

Female dogs were used in the study. After an initial determination of the function of each a solution



of mercuric chloride was injected intravenously in doses varying from 1.8 to 4.4 mgm per kilogram of body weight for 1 or 2 days. One or two days later the right kidney of the animal was decapsulated under ether anesthesia. The capsule was split along the convexity of the kidney and the capsular flaps were allowed to retract. The function of each kidney was studied daily until either death or recovery of the animal took place.

The authors describe the surgical technique they use to collect the urine and estimate the function of each kidney.

A total of 32 dogs were poisoned with mercury. Fifteen animals showed significant changes in renal function and they survived both poisoning and decapsulation for a sufficient length of time to draw conclusions as to the effect of unilateral renal decapsulation. In none of the fifteen animals was there any evidence that the decapsulated kidney functioned better than its control mate.

Following mercury poisoning, the excretion of phenolsulfonphthalein by each kidney in every dog was almost identical day by day even though one of the kidneys had been decapsulated.

The observations made indicated that in a dog (at least if renal function became impaired to the extent that the excretion of the phenolsulfonphthalein had been decreased and the blood urea nitrogen became elevated) the ordinary course of events was death due to uremia.

In no instance did a comparison of the renal function of a poisoned dog suggest that the decapsulated kidney was able to excrete urine of better quality or quantity than the undecapsulated control kidney.

The authors suggested that there was nothing to indicate that the human kidney behaves differently from that of the dog in this respect.

They concluded that in their opinion this experiment did not lend support for the clinical use of decapsulation in uremia due to mercury poisoning.

CONRAD A. KUEHN, M.D.

**Wounds of the Ureter Caused by Firearms (Les blessures de l'uretère par armes à feu).** L. KOJIC and S. PERKOVIC. *J Urol Med.* Par 1914, 34, 8.

Trauma to the ureter is rare because of its small size, elasticity and great mobility. Subcutaneous rupture of the ureter is encountered from time to time in civil practice. Wounds made by sharp instruments are also exceptional and are seldom observed in time of peace. Wounds by bayonet have given way to wounds caused by firearms. Wounds of the ureter are uncommon in times of peace, and very few cases have been found in the literature between the interval of the two wars.

The author was not able to observe a sufficient number of cases following the war to have a great deal of personal experience with this type of injury. During the war of 1914-1918, Decoulx collected 23 cases of wounds of the ureter. Leguen cited 5 cases of Marion, 2 cases of Cathelin and 1 case of Rochet and the author adds 3 of his personal cases.

Walker found 2 cases of isolated wounds of ureter in the American Army and 2 cases in the British Army during the war of 1914-1918. Fein and Epstein found 4 cases of urinary fistula in the Russian Army resulting from wounds of ureter complicated by intraperitoneal wounds which rapidly resulted in death, reported as having occurred in the German Army during the 1914-1918 war. Kuemmel, Fritsch, Rehn, Koerte, Stöckel and Gundelfinger, Kolb and Laewen each observed a patient with a ureteral wound. Recently Gross saw a biliary and ureteral fistula following a gunshot wound. Kimbrough described 8 cases in the American literature, Prather 3 and Lewis 1 case of wound of the ureter caused by firearms, during the war.

The ureter is a very small organ and is rarely wounded. Its great mobility permits it to escape the projectile of a certain velocity. Wounds of the abdominal organs from firearms are frequent enough so that wounds of the ureter are bound to be more frequent than published reports would indicate. In this regard wounds of the ureter are like wounds of the kidney during war.

In the front line surgical ambulances, wounds of the kidney are more frequently found than they are found in the hospitals in the rear. Wounds of the kidney as well as of the intraperitoneal organs are very dangerous. The wounded die on the battlefield or in the front line ambulances.

On the contrary isolated wounds of the kidney or those complicated by less serious wounds are seen in the hospitals to the rear. A large number of cases of wounds of the ureter are accompanied by wounds of the abdominal aorta and the inferior vena cava, and result in immediate death.

The author groups the wounds of the ureter caused by firearms during the time of war as follows:

1. Wounds of the ureter complicated by wounds of the large vessels, abdominal aorta, inferior vena cava, intraperitoneal organs (liver, spleen) or intrathoracic organs. The complications of these wounds result in immediate death on the battlefield.

2. Wounds of the ureter associated with wounds of the hollow intraperitoneal organs or of the peritoneum which mask the wound of the ureter. Ureteral wounds are diagnosed at emergency operation because of the intraperitoneal aspect of the wound. Sometimes the operation reveals the wound of the ureter and at other times the wound of the ureter escapes notice. It is only when a urinary fistula develops that the wound is discovered.

3. The solitary wound of the ureter is rare and most interesting to the urologist. This injury is rare 1 or 2 days after the accident or later when a urinary fistula develops.

The author believes that the experience of any urologist is very limited with this type of case. Therefore a few cases should be studied in order to determine the best operative procedure.

The circumstances surrounding the trauma, the pathology of the ureter and the operative possibilities

ties are very different if the injury is due to an operative involvement of the ureter or if the injury is acquired on the field of battle. On the one side we find the operating room the aseptic wound the early diagnosis in the case of dissection of the ureter during the course of operation, and on the other we have the field of battle, the infected wound, and complication of the pelvic organs. Late diagnosis suggests the essential difference between the two types of ureteral wounds.

The author concluded that wounds of the ureter are rare in time of war as well as in time of peace. Very often they are masked by wounds of neighboring organs or by the pelvic wound. They are discovered at a later date when a urinary fistula develops in the lumbar region.

The author reported 3 cases of injury to the ureter.

In the first case a man of 30 years of age was wounded on April 15, 1945 by a machine gun bullet in the left side of the perineal region. He developed a urinary fistula with pain in the flank and after noon fever. A left nephrectomy was performed on September 27, 1945.

The second case was that of a patient 19 years of age who was wounded by mortar fire on December 12, 1944. The wound involved the right lumbar region. The patient developed pus in the urine and a small lumbar fistula and retrograde pyelography showed the projectile at the tip of the ureteral catheter with a functionless right kidney. On September 15, 1945 a right nephrectomy was done.

The third case was that of a 19 year old man wounded September 28, 1944 by a machine gun bullet which entered the right buttock. Cystoscopic examination showed stenosis 4 cm above the bladder on the right side and a functionless right kidney. On September 29, 1945 a right nephrectomy was done.

The author included diagnostic pyelograms of the cases presented and discussed each case at length.

In discussing the treatment, he observed that it was difficult to apply conservative treatment in this type of injury because it was almost impossible to make an early and exact diagnosis. The late alteration of the wall of the ureter and the periureteral tissues and also the suppuration of the renal parenchyma do not permit hope for a good result from conservative treatment. He outlined the following methods of treatment:

1. Indwelling ureteral catheter
2. Suture of the incomplete ureteral tear
3. Suture of the wall of the complete tear in the ureter
4. Implantation of the superior end of the ureter into the bladder
5. Débridement—simple or extensive without disturbing the ureter
6. The radical operation, nephrectomy

The indwelling catheter may help to close the ureteral fistula. Desnos and Le Fur have reported a case in which this type of treatment was used but they did not make a follow up examination.

Suture of the incompletely severed ureter can rarely be done. Late suture is impossible and it may be better to use an indwelling ureteral catheter. This will permit the urinary fistula to close and also maintain the caliber of the ureter.

Suture of the completely severed ureter has been recommended by some authors but again without much success. Late diagnosis and alteration in the wall of the ureter and the periureteral tissues are the principal factors that contraindicate this type of treatment.

Some authors report successful suture of the ureter and give as proof the closure of the urinary fistula but this closure is at the same time associated with atrophy of the kidney. The proof of the success of suture of the ureter is not complete without ureteral catheterization, pyelography and evidence of good elimination of the urine from that side.

The reimplantation of the torn ureter in the bladder is an excellent procedure but the diagnosis must be made very early. Later the alteration of the structure does not always permit sufficient mobilization of the ureter for this type of operation. Lewis on the contrary implanted the superior end of the ureter into the bladder 6 months following injury and obtained proof by intravenous urography of good kidney function and recession of the hydronephrosis on the wounded side.

Nephrectomy is the treatment applied most frequently. It is done at the time as an emergency procedure. Later it may be done because of alterations in the kidney as well as in the ureter. Often there is no chance to save the organ because nephrectomy is done as an emergency procedure in a gravely injured patient. Later the operation is again rendered difficult and dangerous because perinephritis and periureteritis compress and surround the organs.

The complete débridement of the wound is necessary the first day or two after the wound has been made. Later it is of value to do this procedure in the treatment of urinary phlegmon.

In résumé the author stated that conservative treatment of the wounded ureter can rarely be applied. There is little chance for anatomical and functional conservation of the organ. Nephrectomy is often the only surgical procedure for emergency treatment as well as delayed treatment of the ureteral injury from firearms. CONRAD A. KUEHN, M.D.

## BLADDER, URETHRA AND PENIS

Operation for Excessive Bladder Hypertrophy. E. C. CRABTREE and S. RICHARD MCELINER. *J. Urol.* Balt. 1943 60 593.

The authors consider the persistence of bladder atony with retention of large amounts of residual urine after adequate prostatectomy. Such poor clinical results are puzzling, and further excisions of tissue in the posterior urethra or at the bladder neck are often futile.

In the absence of neurogenic vesical disturbance such failures it is contended are due not to con-

timed obstruction, but rather to a changed bladder muscle. Loss of detrusor tonus is due to marked proliferation of fibrous tissue at the expense of the smooth muscle. Two major histological changes are found: (1) an increase in the pre-existing fibrous tissue which normally surrounds the muscle bundles, and (2) new areas of connective tissue which replace degenerating muscle either wholly or in part. The cause of such scarring is not clear.

In nonsurgical rehabilitation of such bladders, prolonged catheter drainage is suggested in less severe cases. The administration of large doses of testosterone enhancing the tonus of the bladder muscle may shorten the drainage period. As a surgical measure an operation excising two-thirds of the mobile part of the bladder is described and it is hoped that the islands of smooth muscle may regenerate in the remarkable way that bladder musculature does. The small remaining bladder is closed around a cystotomy tube and the obstructive factor is dealt with appropriately. The viscus tends to regenerate to normal size and empty fairly satisfactorily.

Several brief abstracts of cases are cited in support of the points brought out.

ALLAN K. SWERTE, M.D.

**The Importance of Information Furnished by Pre-operative Urethrography and the Results of Urethrotomy on the Immediate Repair of the Urethra, in the Course of Diffuse Perineal Phlegmon** (Importance des renseignements fournis par l'urétrographie pré-opératoire et résultats de l'urétroromie et de la réfection immédiate de l'urètre cours des phlegmons diffus du périnée) L. SARA  
Dart. Med. Acad. chi. Pa. 915, 74-5-5

The frequency of diffuse or circumscribed perineal phlegmon is high in Algeria. It is no wonder" the author stated that urethral pathology is given so much attention in our country. He regarded the so-called "classic treatment" as insufficient, incomplete, routine and old fashioned.

The usual treatment for diffuse perineal phlegmon was described as follows:

After a brief history is taken to determine if the patient has urethritis or not or if he has had a urethritis or stricture, he is placed on the operating table. A long incision is made from the root of the penis into the scrotum, it bisects the scrotum and thus opens the perineum. The finger explores all of the various tracts and tissue planes. If the tissue is copper colored, gaseous, or edematous, and the process extends to the abdomen, suprapubic incisions are also made.

Following surgery treatment with local anti-infectious agents, antigangrenous serum, sulfonamides, and penicillin is instituted.

The scrotoperineal incisions are dressed. Local and general intense antibiotic treatment is indicated.

After the operation the patient often voids through the perineum and he is continually wet with urine. The tissues heal very slowly with numerous fistulas, and it usually takes many weeks for com-

plete healing. The acute phase then subsides, but a chronic periurethritis with stricture formation still exists.

The author makes a preoperative urethrogram, contrary to the present accepted procedure in all cases of perineal phlegmon diffuse or localized, gangrenous or not. He stated that urethrography from a practical viewpoint shows:

1. The site and extent of the stricture.

2. The extent of the infiltration, whether it is a simple periurethral infiltration or a large one extensively involving the perineum.

3. The site of the periurethritis (and thus the site of the lesion can be demonstrated by this method). This provides an important sign for the operator, for it shows him whether the lesion is in the angle of the penis or in the bulb.

These observations are important for one can see the causal lesion and determine its extent. Through the information thus gained in the course of surgery it can be seen that the usual simple operative opening in the perineum may result in a fatality because it is not adequate for the amount of drainage that is necessary.

From a speculative viewpoint, the preoperative urethrography in the course of perineal phlegmon tends to prove Vollemier's contention that there is an infiltration of urine into the perineum and pelvis which is associated with a diffuse perineal phlegmon. This is demonstrated by the diffusion of the contrast media during a perineal phlegmon. The diffuse invasion of the perineum by urine follows the efforts of the bladder working against an obstruction to force out urine drop by drop into the periurethral openings. The site of the pelvic cellulitis has for a long time been thought to be associated with the infiltration of urine following either a perineal phlegmon or a periurethritis.

In practice the urethrography permits one to see the signs of pelvic infiltration of urine visible at the same time as the perineal infiltration of urine. By this method, one is able to see how the pelvioperineal diffusion is produced. The pelvic floor and the perineal spongiosis are not a partition. In the perineum and pelvis there are openings for vessels, nerves, and lymphatics and these openings provide a way for the infection to spread.

At surgical intervention one is surprised to find the bulb, the anobulbar raphe, the rectourethral space, the site of the edema, and lacerated gangrenous and sanious tissues all involved in this destructive process. Here again, urethrography in the course of perineal phlegmon gives important information concerning not only the site of the lesion but its possible diffusion as well. It suggests the operative procedure.

The author first makes a urethrogram before any surgical intervention is done and then continues as follows:

1. In the case of a diffuse perineal phlegmon confined to the perineum a cystotomy with retrograde catheterization of the urethra is primarily done. An



Fig. 1 (Sabadini) Preoperative urethrograms. Urethral opening: massive perineal diffusion of contrast media.



Fig. 2 (Sabadini) Urethrogram showing the healed urethra.

incision is made from the penoscrotal angle to the anobulbar raphe with the electric bistoury. The scrotum is separated into two halves. The infected gangrenous, blackish tissue is removed with the electric knife. The urethra is splinted with a catheter. If it is not possible to catheterize the urethra with one catheter it may be necessary to use two catheters: one catheter placed by the retrograde method through the cystotomy incision and the other through the urethra by means of an incision over the strictured area between the two catheters. In this way the patency of the urethra can be established. The postoperative treatment consists of the administration of antigangrenous serum and large doses of penicillin for several days after the temperature has subsided and there is a general amelioration in the patient's symptoms. Locally dressings with antigangrenous serum, immediate injection of penicillin through the drain and later on Dakin's solution provide the local treatment. After the patient has recovered completely, his care is the same as that of any other patient having a urethrotomy.

2 In diffuse perineal phlegmon spreading to the hypogastrium and the abdomen the technique differs as to the establishment of the cystotomy. The risk of dissemination of the hypogastric infection into the prevesical tissue must be considered. The perineal intervention is then conducted as indicated with more cautious and counter incisions for adequate abdominal drainage. To avoid the constant passage of urine from the urethral opening a Malecot or a de Pezzer catheter is placed in the bladder. In

5 or 6 days, or in a week, it is possible to traverse the abdominal wall without risk of disseminating the prevesical infection. It is advisable then to do a cystotomy to divert the urinary stream and replace the catheter by a rubber splint so that the urethra can reform around it. The author warns that the usual antibiotic medication should not be discontinued with this type of delayed cystotomy for the danger of disseminating the infection does not pass for 3 or 4 days.

3 In the diffuse perineal phlegmon that is associated with pelvic phlegmon the preoperative urethrogram is of great advantage for the invasion of the pelvis is then always recognized. The operative intervention is conducted then with greater precision. The vesical perineal and urethral steps are the same as in all diffuse phlegmons. They permit the bulb and the anobulbar raphe to be opened with the escape of foul serous drainage. The rectoprostatic space is widely opened for this space is distended by the same edema that is present in the rest of the tissues and it represents a serious complication. The fingers explore all of the tissue planes. It is very important to pay particular attention to the side of the rectum and the base of the bladder. The exploration of the lateral sides of the prostate and of the entire membranous urethra should receive special attention. Wicks and drains are left in the retroprostatic cavity and the incision should remain open in its entirety. The postoperative care is the same as that for any perineal phlegmon. It is important to establish pelvic drainage with intermittent

irrigations of penicillin and, after 3 or 4 days to change the penicillin to Dakin's solution.

The author summarizes his experience with more than 30 cases of perineal phlegmon in which he did immediate urethrotomy and in which he made urethrogram prior to surgery. He reported 7 deaths. These deaths usually occurred from 3 to 5 days after surgery, and they usually occurred in those patients who had diffuse gangrene and a very poor general condition with marked toxicity.

In the patients that survived the general condition improved rapidly with local excision of the gangrenous tissue and the large operative incisions healed rapidly. The urethra reform spontaneously over a rubber tube. Occasionally this process could be hastened by suturing of the newly formed tissue about the tube. Usually the healing of the perineum and urethra took place about the same time, from 45 to 60 days. The small fistula in the bulb persisted occasionally. If the fistula persists for a long time the caliber of the urethra should be increased by replacing the tube by means of passage of a sound following the closure of the bladder and if the patient is then unable to void, a sound should be passed 2 or 3 times a day with great precautions to insure asepsis and gentleness. The catheter can be replaced during the night if the nocturnal micturitions are frequent. After healing these patients should return in 3 months for urethral calibration.

C. RAD & ECKEN, MD

#### GENITAL ORGANS

Blastomycosis Involving the Prostate. Mott & Mott and Lash. *Ann K. Matur.* 1944, 1: 100-101.

The thought that blastomycosis might be a causal agent in disease of the prostate rarely presents itself. In 1912 Shepherd and Rhea reported prostatic involvement in a generalized systemic spread of the infection discovered at autopsy. Later several other authors described evidence of blastomycosis in the prostate found at autopsy. Prior to the present report 3 cases were cited in which this disease was discovered during life to involve the genital tract by the presence of characteristic fungus cells in the sediment of centrifuged urine, or in the material from the prostate and seminal vesicles. In both instances, urological complications were preceded by characteristic expectoration of mucopurulent blood tinged material and cutaneous lesions.

The authors present 3 cases of their own. In the first case the initial symptoms were prostatic and the patient was treated with massage. Following this stimulation of a prostatic focus, cutaneous lesions developed. Blastomycosis was identified in examinations of prostatic secretion of urine and in the dense inflammatory infiltrate of tissue blocks from verrucous lip lesions. In the second case a prostatectomy was done for urinary complaints. Sections of the gland were reported to contain numerous focal abscesses. The patient, who presented a

serious cardiac condition had a downhill course. At autopsy histological studies showed blastomycosis in several organs. A review of the previously examined sections of the prostate revealed that the focal abscesses contained pyomycosis dermatitidis, the cause of blastomycosis. The authors stress the importance of examining sections containing abscesses or tuberculous formation with higher magnifications in order to discover or rule out, infecting organisms, especially fungi.

It is conceivable that prostatic blastomycosis, in the absence of cutaneous lesions or characteristic cough with blood tinged expectoration may go unrecognized.

ALLAN K. SWENST, MD

Considerations on the Present State of Prostatic Surgery (Considerazioni sullo stato attuale della chirurgia prostatica). VITTORIO CIULLO. *Pediatrics* 1944, 44: 55-56.

Seventy-four patients with prostatic conditions were received at the Ospitali Civili di Brescia Italy in the period from August 1, 1946 to May 31, 1947. Of these, 3 refused operation and 1 was adjudged inoperable; the remaining 70 were operated upon. The method of Freyer was used in 6. These were from 55 to 84 years of age. Preoperative azotemia was 0.60 per thousand and the largest adenoma weighed 200 gm. Epididymitis occurred in 2 cases, and the average time of incapacity was 40 days. All of the results were good. If a operation was still used in 3 cases. The patients were from 65 to 71 years of age with preoperative azotemia of 0.60 per thousand. The adenomas weighed 10, 15, and 17 gm. respectively. There was 1 case of epididymitis and the period of incapacity averaged 18 days. The results were excellent.

The Wilhelms perineal prostatectomy was employed in 20 patients. These patients ranged from 71 to 83 years of age with azotemia of 0.85 per thousand. The largest amount of tissue removed weighed 80 gm. There was one rectoperineal fistula which developed on the ninth day after the operation and closed spontaneously on the forty first. The average incapacity was 20 days. Nineteen of these patients were cured entirely and 1 was left with urinary incontinence. Millin's retropubic prostatectomy was chosen in 26 of the patients. These ranged from 55 to 70 years of age with azotemia of 0.80 per thousand. The heaviest adenomas removed weighed 105 gm. In 6 cases urine continued to escape from the suprapubic region and the catheter had to be reintroduced for from 4 to 6 days. In 1 case turbid urine persisted for 4 months after the operation. The average period of incapacity was 21 days. All of the patients were cured. Finally the transurethral resection was done in 13 patients. These ranged in age from 47 to 86 years. The average azotemia was 0.95 per thousand. The largest amount of tissue removed by this method weighed 48 gm. There were no complications, and the average incapacity was 15 days. All of these patients left the service urinating easily with a residual urine of from

0 to 20 gm. There was not a single death in the entire group.

As might be expected the Freyer method was chosen for the largest prostate glands and those most difficult to manage; the aseptic method of Hey and the retropubic method of Millin being reserved for those patients with smaller more easily enucleable tumors and in the absence of infection. Wildbolz's method was reserved for the smaller adenomas and for the older patients representing a poorer risk and for those patients in the younger group in whom enucleation by this route seemed practicable and who did not object to the greater threat of permanent sexual impotence.

The author believes that the generally good results attained in these cases are due to the fitting of the various procedures to the pathological conditions encountered and that the constant adherence to one method would result in the necessity for a greater selectivity (in this group operation was done in 98.6 per cent of all cases) in the choice of cases for operation or the results would not be so good.

JOHN W. BRENNAN, M.D.

Undescended Testes. EDWARD W. BEACHE, *J Urol*  
Balt. 1948, 60: 673.

The author surveys the subject of undescended testes comprehensively and stresses the importance of early recognition of the problems involved and of the application of intelligent hormonal and surgical measures as indicated.

Differentiation is made between the larger group of undescended testes in which the retention is caused by anatomic or mechanical obstruction and the relatively small group in which descent arrest along the normal route is due to hormonal disturbance. To the end of obtaining healthy spermatogenesis it is necessary to have the testis reposing in the bottom of the sac prior to the onset of puberty. After that stage is reached the retained gonad undergoes atrophic changes.

Hormonal therapy in the form of chorionic gonadotropin at the age of 7 or 8 years is advocated. Henderson is quoted as recommending a dosage of 500 international units three times weekly for 6 weeks then 1,000 international units twice weekly for 2 weeks if descent is manifest. If no progress is noted the hormone must be stopped because of danger of an irreversible precocity syndrome and surgery should be considered. The author discusses developmental history of testicular descent, including the role of the gubernaculum as a continuous cord connecting the lower pole of the testicle to the bottom of the scrotum. This structure tunnels through the abdominal wall and fashions the inguinal canal in advance of the gonadal descent. The testicle is pulled down "like a log upon a sledge" into the scrotum.

Anatomic factors associated with testicle retention include spermatic cord difficulties which vary with position of the testis the greatest problem with elongation being experienced when the organ is

lodged in the internal ring. No single cord component was at fault in this series of 46 cases since diffuse bands and adhesions usually matted the various structures together. As a whole the cord was always adherent to the peritoneum and had to be freed from it on the posterior and lateral walls of the abdominal cavity. The author feels it permissible to cut the vas if necessary, to gain length. The spermatic artery however should not be cut for that purpose because testicular atrophy frequently follows. Some degree of hernia or potential hernia existed in almost every case. In the repair of simple indirect hernia to avoid shortening of the cord the Ferguson technique was used, which brought the cord beneath all muscle layers to emerge near the external ring. Coexistence of direct hernia worsened matters because of the necessity of reinforcement of the posterior canal. In these cases the Wyllys Andrews technique of overlapping the external oblique behind the cord was employed.

Orchiopexy was performed 32 times with the use of various standard methods. Orchiectomy was done 17 times always in the presence of a sound contralateral organ. In these cases it was not possible to carry out an adequate orchiopexy and it was believed that removal of the testicle obviated the greater danger of malignancy in maldescent. In unilateral involvement if the testicle showed gross atrophic changes after the age of 18 it was removed. In bilateral involvement, every effort was made to preserve at least one gonad.

ALLAN K. SWERDLE, M.D.

Testicular Atrophy Accompanying Liver Cirrhosis  
(Atrofia testicular de la cirrosis hepática) M  
*Maximil. Dis. med.* 8 (1948), 20: 2066.

The observation has repeatedly been made that patients with cirrhosis of the liver develop an atrophy of the seminiferous tubules with alterations of the interstitial cells. Apparently some relations exist between the hepatosplenic apparatus and the endocrine glands. According to another theory the process of fibrosis may involve in addition to the liver also other organs. Such a condition is called "sclerogenic diathesis." The fibrous alterations may be found in the pancreas, genital organs, the thyroid and adrenal glands. Other theories have been advanced to explain the simultaneous occurrence of cirrhosis of the liver and atrophy of the testes, e.g. hypofunction of the testes caused by a constitutional dysfunction, an untoward effect of the liver on the endocrine glands functionally connected with the testes, and an effect of the diseased liver on the areas of the central nervous system regulating the sex life.

The concomitant occurrence of cirrhosis of the liver and testicular atrophy is not a pure coincidence. Zoedek maintains that inactivation of sexual hormones by the liver is caused by the enzyme estronase. This enzyme is able to destroy the biologic activity of certain estrogens in vitro. The latter may inhibit the testicular function by impairing the gonadotropic effect of the anterior lobe of the hypophysis.

The testicular atrophy usually develops during the histologic activity of the hepatic lesion

JOSEPH K. NARAT, M.D.

Orchiopexy. LEONARD PAUL WEINSTEIN. *J Urol*  
Balt., 1948, 60: 631

A critique on orchiopexy is presented which emphasizes the regional anatomical features and the advantageous aspects of accepted surgical procedures and recent modifications.

Reference is made to McGregor's principle of a "third inguinal ring" which plays an important part in the retention of the testis in the scrotum. This is a gateway to the scrotum and is stated to be situated to one side of the midline  $\frac{1}{4}$  to 1 inch below the upper border of the pubis and external inguinal ring in the adult. Clinically when one invaginates the scrotum with the finger to feel the external ring, the finger passes through the third ring. Medially the boundary is the root of the penis and suspensory ligament, and laterally it is the ligament of Scarpia. The pursestring suture placed at the neck of the scrotum through the deep skin fascia and aponeurosis of the external oblique after placing of the testicle in the lower part, approximates or reconstructs the ring.

The formation of a loose scrotal sac particularly in those cases in which the sac is small requires more than blunt finger separation of elastic connective tissue fibers in the scrotum. Vermooten's recently published modification of the Bevan technique in preparation of the scrotal bed is approved. To obtain a bed that will permit the testis to remain it is suggested that the elastic fibers be divided by knife over a sponge stick, evaginating the most dependent portion of the scrotum into the wound. The normal elasticity of the scrotal tissue which tends to push the testis out, is thus counteracted. Anchorage of the testis by the tying of a gubernacular suture outside the scrotal wall is advocated. Traction with an elastic band may be used if desired but if there has been adequate preparation of the scrotal bed and freeing of the cord from adhesions with sufficient lengthening, and pursestring suture at the neck of the scrotum this should not be necessary.

The author prefers the Bevan technique with modifications utilizing applied anatomical factors.

ALLAN K. SWERDLE, M.D.

### MISCELLANEOUS

Surgical Indications in Genitourinary Tract Infections. ROGERS DEAKIN. *J Pediatr* St. Louis, 1948, 33: 357

The present article deals with the author's concept of pediatric urologic problems based upon 15 years of experience in the management of urological problems in children observed in the St. Louis Children's hospital. The prevention or elimination of infection is a frequent concern to both the pediatrician and the urologist in a great many cases that present urological problems.

Urinary tract infections in infants and children that require urological investigation and surgery constitute about one-tenth of those that are encountered. The remaining 90 per cent, predominantly pyelitis or pyelonephritis, respond to chemotherapy sufficiently well to recover unless repeated recurrences take place. Malnutrition and a history of longstanding or repeated urinary infections are the rule in those cases that do not respond to chemotherapy.

The investigation of a child suspected of having a surgical infection in the urinary tract begins with a careful microscopic examination of the urine. The microscopic and cultural methods of urinary examination are of considerable importance in the management of a child with urinary tract infection.

The presence or absence of residual urine must be determined early in those cases. The initial determination of the amount of residual urine is an important examination, and great care must be taken so that it is accurately done.

Cystograms furnish a permanent record of the bladder contour and capacity. The amount of fluid introduced into the bladder for this purpose will vary with the size and the age of the child. The pictures of the bladder obtained by intravenous urograms may eliminate the need for cystograms in some cases because the former frequently outline diverticula, distortions of the bladder, or vesical foreign bodies. They do not, however, disclose regurgitation into the ureters in the same diagnostic way that a cystogram does. If no residual urine is present, the amount of opaque fluid comparable to that expelled in an average voiding can be used in performing the cystogram.

Intravenous urography is a useful agent for diagnostic purposes. Too much cannot be expected from intravenous urography in all cases. If the renal function is good and no obstruction or stagnation is present, the media may be excreted so rapidly that little information about the kidney architecture can be obtained. On other films the radio-opaque material will be of insufficient concentration to be of diagnostic importance. The most serious disadvantage of intravenous urography is that the films frequently fail to show minor defects in the kidney defects that are readily demonstrated by retrograde studies. Intravenous urography is of great value if cystoscopy and retrograde pyelograms cannot be made.

The improvement made in infant cystoscopes in recent years greatly facilitates the urological investigation of children. The superiority of cystoscopy and retrograde pyelography over intravenous urography lies in (1) actually seeing within the bladder and the urethra, (2) being able to catheterize the ureters and to obtain separate specimens of kidney urine (3) securing differential functional tests from each kidney and (4) repeating retrograde pyelograms when necessary.

Routine enemas are not used by the author to eliminate intestinal gas. If fluoroscopy or a scout film before radiographic studies reveals too much gas

for satisfactory films the intravenous or retrograde pyelograms may better be postponed until another time. Intestinal gas does not interfere with retrograde pyelograms as a rule because of the greater density of the radio-opaque media.

To certain patients in whom these diagnostic procedures and the exercise of the best clinical judgment still leave the diagnosis in doubt it may be necessary to perform a surgical exploration of the mass in the flank, and to inspect and take a biopsy of the questionable lesion.

The fundamental principle in the management of all surgical complications of infections in the genitourinary tract is the prompt establishment of free drainage and the elimination of all stasis. Every effort must be made to preserve tissues and structures and to restore them to normal function. Plastic or restorative surgery plays an important role in the management of these cases.

Bladder neck and posterior urethral obstructions are divided into those in which the basic factor of the obstruction is neurogenic in origin and those in which a mechanical defect at the bladder neck causes the obstruction. Examples of the neurogenic group include children who have spina bifida occulta, meningeoceles, cord tumors or injuries to the spine resulting in paralysis of the lower extremities with loss of vesical and anal control.

A conservative program of therapy is usually employed in these cases with particular emphasis upon the control of infection.

The types of obstruction which are most common in children are contracture of the vesical outlet, congenital valvular obstruction of the prostatic urethra, congenital hypertrophy of the verumontanum, ureterocele, prostatic lobes and neuromuscular disease.

In both types of obstruction, the same serious complications, i.e. stasis and infection are present with renal insufficiency as the eventual outcome if these two factors are not successfully combated. The mechanical obstructions are more amenable to surgical correction and therefore offer a better prognosis if they are not too far advanced before operation.

Transurethral resection of bladder neck obstruction can be done by using miniature instruments. At the risk of having to repeat the operation one or more times, it is wise to proceed cautiously and with extreme consideration of these tiny structures rather than to try to remove too much tissue at one time.

Cystostomy does provide adequate drainage and may be advisable if diverticula of the bladder requiring removal are present. The scalpel removal of bladder neck obstruction via a cystostomy is notoriously inaccurate and difficult. Cystostomy has the added disadvantage of delaying the evaluation of vesical neck surgery until the bladder has again become a closed viscus. It has not been proved that an open and therefore a contracted bladder may not in fact contribute additional obstruction to the ureters by the pressure of the thickened bladder wall upon the intramural portion of the ureter.

Unexplained ureteral dilatations of a severe degree are sometimes identified as megaloureter or congenital hydroureter. These ureters are usually infected and as a rule the kidneys and ureter are so badly damaged as to necessitate a nephroureterectomy if the condition is unilateral.

Dilatation of the ureter due to mechanical causes falls into two general classifications: (1) those due to extrinsic factors and (2) those due to intrinsic factors. Those due to extrinsic factors consist of aberrant vessels and fibrous or scar tissue bands and they are usually found at the ureteropelvic junction. This type of obstruction produces constriction of the ureter resulting in urinary obstruction and dilatation which in turn causes stasis, infection and renal damage.

Intrinsic obstruction to the ureter implies a disturbance within the ureteral wall or lumen itself such as stricture, constriction, stenosis, foreign body such as a stone or a ureteral tumor.

A wide variety of technical operations have been devised to relieve ureteral obstruction. The chief handicap to a successful operation is that many of these ureters have been stretched to almost paper thinness and this makes any form of plastic repair difficult with an unfavorable prognosis.

Regurgitation of urine upward in the ureter is an interesting phenomenon both because of its frequency and because of the uncertainty of its origin. A patulous orifice might suggest a purely mechanical origin for the regurgitation yet urinary regurgitation can occur with orifices that are not patulous and appear quite normal. Many dilated and patulous ureters regain their normal tone and lose their dilatation if a bladder neck obstruction is successfully relieved. There seems to be some relationship between the response of the bladder wall and the response of the dilated ureter to an operation on the bladder neck. Both the ureter and the bladder respond to the operation in about the same degree.

The ordinary anomalies of the kidney are single or polycystic renal disease, horseshoe and ectopic kidney. All of these conditions are associated with infection and pyuria is the presenting sign that leads to the discovery of the anomaly. The surgical intervention in these cases, either in the presence or absence of infection will depend upon whether surgery will be helpful. Each case has to be handled individually.

Renal tuberculosis in children usually is accompanied by tuberculosis elsewhere. If a proved case of unilateral tuberculosis is encountered, nephrectomy should be seriously considered. It may be, however, that further experience with streptomycin in tuberculosis will warrant a nonsurgical approach to this type of case in the future.

Calculus disease in children is more often a medical or a metabolic problem than a surgical one. Both kidneys are usually involved and whether the kidney substance itself is riddled with calcium material or the pelvis and calyces are full of stones, surgery is likely to be impracticable and of no avail. If a frag-



ment of stone breaks away and lodges in the ureter surgical removal of the calculus may be necessary. Rather than risk further mutilation of the kidney by surgery, the control of infection and correction of the metabolic disorders as far as possible may be advisable before surgery is attempted.

Whenever the urologist is confronted with a choice of either sacrificing a kidney or perhaps a more difficult task of trying to repair it, he should remember that the genitourinary structures of a child exhibit amazing inherent reparative properties, and this may be the determining factor in choosing a more conservative treatment in the individual case. There must be favorable assurance that before the nephrectomy is done, the remaining kidney will support life. On occasion a heminephrectomy or a calycoectomy may be done to remove the diseased portion of the kidney with retention of the normal part.

An incision made downward through the strictured area and sutured across, the course of the ureter at right angles to the incision has proved to be a popular plastic technique for the repair of ureteral strictures.

As a rule no definite plastic procedure can be planned until the kidney or ureter has been exposed and the exact nature of the obstruction determined. Two principles must be kept in mind: to construct free drainage to the kidney that will permit no ac-

cumulation of urine and to provide adequate drainage for the parts during the convalescent period.

A nephrostomy may have to suffice on occasion when it is imperative to establish immediate drainage of an infected kidney with the minimum of surgical shock. A dilated ureter is a good site for drainage in hydronephrosis or hydroureter. The conventional T tube is a very satisfactory drainage tube in this location.

Diversion of the urinary stream by means of ureterointestinal anastomosis or ureterocutaneous transplant with or without cystectomy is an established procedure in children as well as in adults.

The drugs most commonly used at the present time as urinary antiseptics are the various sulfonamide derivatives penicillin streptomycin, mandelic acid methenamine and the various alkalinizing agents. The preoperative use of chemotherapy is advisable and should be continued during the postoperative period as long as fever or pyuria persists.

Too much benefit should not be expected of any antibacterial agent as long as a mechanical problem of stagnation or stasis exists. The most potent aid that can be given drug therapy is the restoration of a normal current of urine through the urinary passages.

The article is well illustrated with pyelograms of many interesting pediatric urological cases.

CONRAD A. KUBER, M.D.

# SURGERY OF THE BONES, JOINTS, MUSCLES, TENDONS

## CONDITIONS OF THE BONES, JOINTS MUSCLES, TENDONS ETC.

**Anatomoclinical Study of 2 Cases of Primary Tuberculosis of Striated Muscles (Considerazioni anatomocliniche su due casi di tubercolosi primaria dei muscoli striati)** RENTO CORREI and GIORGIO VENTURI *Arch Ital chir* 1948, 70 216.

As a rule, tuberculosis of the muscles is secondary to a specific process in other organs. A primary lesion of the muscles is very rare. Tubercle bacilli may reach a muscle either through the blood stream or by contiguity. Tuberculosis of hematogenous aspect may assume one of two forms: (1) miliary in the form of grayish nodules which may show a tendency to confluence and caseinization or (2) circumscribed with casein formation in the center and a large fibrotic peripheral zone. Fungus or abscess formation with complete liquefaction of the center may result.

The involvement of a muscle by contiguity is observed more frequently and may follow pleurisy, osteoarticular lesions or lesions of the lymph nodes.

The authors apply the term primary tuberculosis to a lesion which is of hematogenous origin. He refers to reports in the literature of 92 cases of primary tuberculosis, and reports 2 cases of his own.

A cystic tumor was removed from the left pectoralis muscle in a woman 48 years of age. The Ziehl stain of the specimen failed to reveal tubercle bacilli but the presence of Langhans cells and other typical findings established the diagnosis.

There was no history and no evidence of a specific lesion in any other organ. The skin reaction after the operation was positive.

A man 22 years of age with a previous history of a right exudative pleurisy developed a swelling over the right latissimus dorsi muscle which was diagnosed as either a sebaceous cyst or a granuloma of unknown origin. Although no tubercle bacilli could be detected in the specimen the presence of giant cells and other typical findings established the diagnosis of tuberculosis.

The general condition of both patients was good.

The preoperative diagnosis of such lesions is very difficult unless changes in other organs can be detected. In the differential diagnosis, one should consider various neoplasms, infestations of parasitic origin and specific inflammations caused by syphilis, lepra, actinomycosis, sporotrichosis, anthrax.

Three types of tuberculosis of the muscles may be distinguished: (1) nodular (2) sclerofungous and (3) abscess.

Early and radical surgery is indicated and should be followed by postoperative x-ray therapy. Medical dietetic, and hygienic measures should supplement local treatment. JOSEPH K. SARAY, M.D.

**Cavernous Angioma of Striated Muscle (Sull'angioma cavernoso dei muscoli striati)** PIERO FORCINI and ALESSANDRO FICAT *Glor Ital chir.*, 1948 4 347

The authors describe a case of angioma of the flexor muscles of the forearm and analyze the clinical characteristics and the histopathology of the classification. They believe that the case they describe must be considered as an angioblastoma according to the classification proposed by Costa. This tumor has no relationship to trauma, and the inflammatory processes must be considered as congenital on the basis of a disturbed mesenchymatous tissue proposed in a sense by Albrecht.

The authors give a detailed report of an adult male age 20 whose personal history was essentially negative. For a period of 5 years the patient had noticed a double tumefaction of the middle third of the right forearm. The tumor was about the size of a walnut and produced no incapacity of the arm. Some pain was produced by pronation of the forearm and flexion of the fingers. The mass was surgically removed without difficulty and healing was by primary intention. Sections of the tumor mass are shown in the article.

The authors have collected over 300 cases of angiomas from the literature and have presented a résumé of the subject. CARLO SCUDERI, M.D.

**Calcifying Tendinitis of the Shoulder** NEWTON C. MEAD, Q. *Bull Northwest Univ M School* 1948 22 270.

Calcifying tendinitis is the commonest cause of pain and disability of the shoulder. Although frequently called "bursitis" the calcium occurs and remains in the substance of the tendon until it points and ruptures. The bursal floor becomes inflamed as a result of this but this bursitis does not resemble the process so commonly met with in other bursae of the body in which the bursa following overuse or direct injury becomes tender, painful and distended with fluid. A similar calcifying process occurs in tendons and ligaments elsewhere in the body as in Pellegrini-Stieda's disease in which no bursa is present.

The etiology is uncertain. It is commonly stated that it is a degenerative condition resulting from trauma of the tendon. There is no reason to doubt this but it is interesting to note that only 12 of 180 patients studied gave a clear-cut history of a traumatic origin of the condition. No relation of the disease to the occupation of the patient could be found. Overhead workers such as painters and plasterers do not appear to be frequent sufferers. In the male the distribution between the right and left shoulders in this series is exactly even. Surprisingly in the female patients there is a marked

preference for the right shoulder over the left a ratio of 67 to 31. No explanation for this is apparent.

The best available information of the pathology of this condition is given by Codman. He found degenerative areas in many shoulder tendons which appeared to be due to traumatic rupture of a few of the internal fibers. He also found ovoid bodies similar to rice bodies occupying the defect in the tendon and believed them to be the precursors of the calcified mass. What occurs to cause the calcification and inflammation is not known but at times there is a definite relationship to additional trauma. The truly disabling severe symptoms do not occur until the calcified mass has expanded and is protruding under the serosal floor of the bursa. It thus produces a bursitis of a definite inflammatory nature. However the bursa rarely becomes distended with fluid. Codman pointed out that if the subdeltoid bursa is distended, it is very good evidence that there is a rupture of the musculotendinous bursal floor and a communication with the shoulder joint proper. The calcium itself is not chemically irritating, as is proved by the relative absence of pain in patients in whom the bursal sac is full of a calcified suspension. The excruciating pain is directly related to the tension within the calcified deposit while it is still imbedded in the tendon.

The author divides his cases into four types.

1. Acute calcifying tendinitis (61 cases). In this condition the onset is sudden and the slightest motion of the shoulder is agonizing. The patient is completely disabled. The acute symptoms last from 3 to 7 days without treatment. There is gradual recovery without disability in several weeks or months. Roentgenograms taken during the height of the symptoms will show a mass of imbedded calcium in the fibers of one of the tendons of the musculotendinous cuff which makes up the floor of the subacromial bursa. After the severe pain has subsided, calcium is seen in a much less dense form in the dependent portion of the bursa itself but the calcium in the tendon will not have changed greatly in appearance. Roentgenograms a month later will, in favorable cases, show complete disappearance of the calcium from the area.

2. Chronic calcifying tendinitis with acute exacerbation (43 cases). If untreated, the acute attack will end spontaneously after a few days or weeks, but the calcium will not disappear from the tendon and the symptoms of chronic tendinitis persist.

3. Subacute calcifying tendinitis (17 cases). The onset is gradual and there is never the intensity of pain seen in the acute type; the condition does not subside spontaneously except after very long periods.

4. Chronic calcifying tendinitis (37 cases). The calcium seen in the roentgenogram has a hard dense appearance and may vary from a small speck to a very large mass. The shoulder will not rotate easily and abduction is limited usually with pain as the greater tuberosity passes beneath the acromion.

Surgical decompression, either by needling or open incision of the mass, is a logical and very effective

method of treating patients with acute cases and an acute flare-up in chronic cases. It is not indicated in chronic cases as the deposit is not under tension. In these cases symptoms result from the tendinitis itself and the bursitis associated with it. The pain is at its worst when the degenerated tendon is under tension or when its insertion is brought into contact with the acromion as in abducting the arm. In the latter case the tip of the acromion may be removed. The technique of needling and surgical decompression is described in detail.

JOHN J. CRANLEY, JR., M.D.

**Subcutaneous Rupture of the Extensor Pollicis Longus Tendon** (*Rottura sottocutanea del tendine del lungo estensore del pollice*). *LIBERO VASILE, Polidina, sez. prat.* 1948, 55: 550.

The author reports a case of subcutaneous rupture of the extensor pollicis longus tendon that was diagnosed one month after an injury to the thumb with out any fracture or breaking of the skin.

The patient was operated upon and repair was accomplished by suture of the distal portion of the extensor pollicis longus tendon to the extensor pollicis brevis tendon. The result was excellent.

The author reviews the literature and proposes a classification based on the mechanism of the rupture.

The first case was reported in 1876 by Duplay. Eighty five cases were reported in the literature up until 1933.

CARLO SCORSAI, M.D.

**Anatomical Studies on Lumbar Disc Degeneration.** *STEN FÄRBERG, Acta orthop scand* 1948, 17: 14.

One hundred lumbar vertebrae together with the sacra were removed as soon as possible after death, and permitted the study of 500 intervertebral discs and 1,000 intervertebral joints. The sacrum was fixed in a vice and the specimens were sliced and extended without force, and so roentgenographed. After a short period of formalin fixation, the discs were cut horizontally and macrophotographed. The intervertebral joints were removed separately and decalcified. These investigations have not yet been concluded, and an effort will be made to study the relation between disc and joint changes.

Histological examination of disc material shows that regressive changes in the nucleus occur early. These are interpreted as signs of a normal age involution rather than pathologic degeneration. As the age increases, the amount of fluid in the nucleus decreases, fibrosis increases, and the borderline between the disc and the annulus becomes less distinct. This occurs without clinical signs or degenerative symptoms. When fissure formation is found in the annulus, degeneration has occurred.

Anatomical investigation of the degeneration shows variations according to the disc level in the lumbar spine. In the upper lumbar region the disc degeneration showed a concentric arrangement, and fissure formation was observed all around the disc. In the two lower discs the degeneration was situated mainly in the lower portion. A sagittal path ex

tended from the nucleus dorsally to the posterior longitudinal ligament, running out on both sides in the form of a T and often extending to a point slightly lateral to the intervertebral foramen. Schmorl, Jannhanns, Guentz and others have pointed out that in the thoracic region the anterior portion of the disc is affected owing to the greater anterior pressure after the disappearance of the nucleus. The author believes that the lumbar lordosis contributes to the specific type of lower lumbar disc degeneration.

Disc degeneration was found in the backs of 32 patients and disc prolapse was found in 11. In those with prolapsed disc, extensive degenerative changes also were present. It was found that in all cases in which a disc showed roentgenological instability without other roentgenographic indication of disc degeneration (reduction in the height of the disc, osteophytes, and sclerosis) fairly widespread fissure formation was nevertheless present in the annulus especially posteriorly.

Disc prolapse is the result of previous disc degeneration the trauma playing the part of the liberating factor. A negative roentgenogram does not preclude the existence of fairly advanced changes in the disc.

The author favors lumbosacral fusion early as soon as instability is diagnosed. His studies have shown that in cases in which extensive laminectomies have been performed previously lumbosacral fusion has given unsatisfactory results.

DANIEL H. LEVINTHAL, M.D.

#### Eighteen Observations of Bilateral White Tumors of the Knee (A propos de dix huit observations de tumeur blanche bilatérale du genou) P. INGELRAMS, A. VERDUREUX and NICOL. *Lille chir.*, 1948, 15, 115

During a period of 28 years the authors have observed 69 unilateral and 18 bilateral tuberculous tumors of the knees. In other words, the bilateral lesions occurred in 25.3 per cent of the patients—7 males and 11 females—and the youngest patient was 2 years of age. Six patients were younger than 10 years, the ages of 7 patients ranged from 10 to 21 years, the ages of 3 ranged from 21 to 25 years, 1 patient was 34 years, and 1 was 54 years of age.

In 7 cases other osteoarticular lesions were present, in 3 the pleura and the lungs were involved and in 2 specific visceral conditions were discovered.

As a rule, one side was affected to a higher degree than the other. Not infrequently the patient suffers osteoarthritis on one side and synovitis in the opposite knee and during treatment of the osteoarthritis a clinical recovery of the synovitis is effected and the patient resumes his activity but after awhile a recurrence of the synovitis takes place. The remission may last a few years in children but is usually shorter in adults.

Inasmuch as roentgenographic examination frequently fails to give sufficient information and the symptomatology of synovitis may be very scanty

other diagnostic methods are necessary. The use of various culture media and even inoculation may give negative results. Successive passages through a few guinea pigs may be necessary to reveal the presence of tubercle bacilli. Biopsy of the synovia is of great diagnostic value.

The establishment of the correct diagnosis is essential because positive findings suggest a resection. This is a grave decision because a bilateral ankylosis of the knees results from the operation.

The authors have discontinued treatment by synovectomy because it produced unsatisfactory results.

In spite of a bilateral ankylosis of the knees some times accompanied by an ankylosis of the hips, the functional results may be more or less satisfactory. The authors were able to obtain 8 cures, while 1 patient succumbed to pulmonary complications.

JOSEPH K. NARAT, M.D.

#### SURGERY OF THE BONES, JOINTS, MUSCLES, TENDONS, ETC.

Resection of the Lower Extremity of the Ulna (La résection de la extrémité inférieure du cubito)  
HERBERT CAENOLI and JORGE GARCIA NOVALES. *Ar. ortop. traum.*, 1948, 1, 69.

Although mutilating from the anatomic point of view from the functional viewpoint resection of the lower extremity of the ulna offers chances of restoration or preservation of the movements of pronation and supination.

The operation should be considered when one of the following conditions is present:

- Recent fracture (a) fracture of the lower end of the radius with dislocation of the ulna, (b) fracture of the lower end of the ulna, irreducible by closed methods with lower radioulnar dislocation and (c) comminuted fracture of the lower ulnar epiphysis.

- Old fracture and its sequelae (a) metaphyseal or diaphyseal fracture of the radius with dorsal or radial angulation causing a palmar or dorsal subluxation of the ulnar epiphysis, (b) fracture of the lower end of the radius with angulation, (c) fracture of the lower end of the radius with shortening of the bones responsible for a dislocation of the lower radioulnar articulation, (d) fracture of the lower extremity of the radius, well reduced from the anatomic point of view but distorting the lower radioulnar articulation and (e) sequelae of a fracture of the lower ulnar epiphysis.

- Sequelae of a fracture of the lower extremity of the radius causing functional disturbances such as pain and limitation of supination.

- Traumatic dislocation of lower end of ulna.
- Tumors of the lower end of the radius or ulna.
- Arthrosis or ankylosis of the lower radioulnar articulation.

- Madelung's congenital deformity.
- Sequelae of acute, subacute, or chronic arthrosis of the radiocarpal articulation if arthrodesis is indicated.

p. Arthrosis of the radiocarpal articulation of traumatic origin, usually following the pseudo arthrosis of the navicular bone if surgical arthrodesis is indicated.

The authors illustrate the value of the method with reports of 31 cases.

The bone is resected with a Gigli saw through a longitudinal incision over the lower end of the ulna.

JOSEPH K. VARIT, M.D.

Osteotomy of the Vertebral Column; Smith Peter sen Operation (Osteotomie de la colonne). *Arch. et Soc. Neurolog. P. neuro. med. argent.* 1918, 35, 536.

The author describes an operation for the correction of the simian type of posture created by the various types of spondylitis especially the rheumatic form.

In a staged procedure the author removes the intravertebral fibrocartilaginous disc between the second and third lumbar vertebrae after forceful maneuvering of the vertebral column into an upright position as shown in Figure 1. The results obtained have been gratifying.

A lateral approach, and the use of an iliac graft including both hip joints in a corset permits early ambulation with the assurance that there will be no recurrence of the flexion. It is believed that these steps have greatly simplified the operation for curvature of the spine.

STEPHEN A. ZIEGLER, M.D.

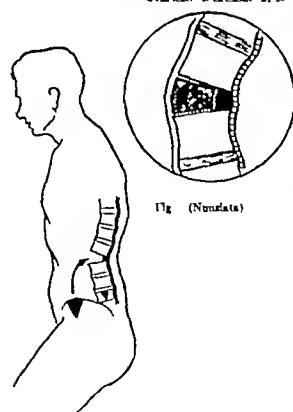


Fig. (Normal)

A Procedure of Foot Disarticulation with Partial Conservation of the Calcaneus (Sur un procédé de disarticulation d pied avec conservation partielle du calcaneum). *L. Ricard. Lyon M.* 1918, 47, 299.

The author discusses the disadvantages of the different classical methods of foot amputation (Chopart, Symes, Pirogoff and others). He devised a modification of the Symes operation in which a part of the calcaneus is saved and mortised between the malleoli, with or without resection of the Achilles tendon. With this procedure the drawbacks of the Symes operation—undue shortening of the leg, and weight bearing by the leg bones—are avoided. At the same time it provides ample skin covering for the stump.

WESLEY M. SOMMER, M.D.

## FRACTURES AND DISLOCATIONS

Treatment of Simultaneous Fractures of the Two Bones of the Forearm, Particularly in Children (Traitement des fractures simultanées des deux os de l'avant bras, en particulier chez l'enfant). *Mass. Med. Soc. Rep. orthop.* 1917, 1918, 34, 213.

Fractures of the diaphyses of the radius and ulna in children are usually less serious than those in adult. However this fact is no excuse for any neglect because all of the complications are encountered at all ages and many poor results are not helped by growth and some even become worse.

In addition to the correction of deformities and the maintenance of good reduction it is necessary to avoid pseudoarthrosis and exuberant callus in fractures of the forearm. The correction of deformities includes correction of length, which necessitates clinical and roentgen examination not only of the two bones but also of their articular extremities preservation of the pronator curve of the radius and of the width of the interosseous space and correction of displacement. The maintenance of the fragments in good position requires supervision by successive roentgen examinations because secondary displacements are particularly frequent in the forearm. Pseudoarthrosis can be prevented by immobilization for a period of at least 6 weeks which must sometimes be increased especially after surgical intervention. To prevent the formation of excess callus and synostosis, all causes of osteoperiosteal irritation must be eliminated; massage must therefore be rejected and long continued immobilization assured.

Greenstick fractures which have been neglected because of their supposed benignancy are sources of disappointment if they are not perfectly reduced with complete fracture of the cortex and immobilization for an average of 6 weeks.

Most fractures in children respond to proper orthopedic treatment. Irreducible and some intracapsular fractures require surgical treatment. Simple replacement of the fragments is often enough. Among the classical methods of fixation the author prefers central pegging preferably with fresh bone and Ombredanne external synthesis with screws and

connecting plate. This requires only one operation and the apparatus adapt themselves well to the phenomena of growth. If only one bone is fixed it is best to choose the radius as its shortening is much more serious than that of the ulna if necessary the ulna is fixed after the radius.

The insertion of a stainless steel pin into the medullary canal instead of Kuntscher's nail tends to replace the old methods of synthesis in children. Its ease of introduction into the ulna makes this the operation of choice for this bone. The operation is somewhat more complex for the radius. The pins must respect the epiphyseal cartilages. It is logical to begin with the bone which is easiest to handle, (the ulna) the radius is then often reduced spontaneously if not, it is also fixed. Fluoroscopy should be available in the operating room to control the reduction. The method should not be regarded as a panacea that can be used without all the precautions required by bony synthesis. RICHARD J. BENNETT, M.D.

#### Dislocation and Fracture Dislocation of the Pelvis F. W. HOLDSWORTH, *J. Bone Surg.* 1948, 30-B 461

The author's article is based on a study of 50 cases of fracture of the pelvic ring. Two types of fracture are listed: (1) dislocation of the sacroiliac joint, and (2) fracture of the ilium or sacrum adjacent to the sacroiliac joint. In both types there is separation of the symphysis pubis or fracture of both pubic rami. In both there is outward displacement of one half of the pelvis.

Forty-two patients survived and were followed up (27 with dislocation of the sacroiliac joint and 15 with fracture of the ilium or sacrum near the joint).

Visceral complications and injury to the bladder and urethra were rare in this series; there being only 4 cases of injury to the bladder and urethra. Two patients had large extraperitoneal tears in the bladder and both died. Retroperitoneal hemorrhage was a more frequent complication and was the cause of death in 4 cases. Fractures of the pelvis were treated by suspending the patient in a canvas sling. Both lower extremities are placed in Buck's extension with slight flexion at the hips. Manipulation may be necessary if there is a rotation displacement. Fixation is maintained for 12 weeks.

The average period of follow-up is 5 years and no case is followed for less than 2 years. About one half of the patients with sacroiliac dislocation were able to return to reasonably heavy work and practically all of the patients with fracture were able to do so. The frequency of persistent sacroiliac pain after dislocation suggests that early sacroiliac fusions should be suspected.

RICHARD J. BENNETT, JR., M.D.

#### Pathologic Dislocation of the Hip Joint. A. F. BRY SON, *J. Bone Surg.* 1948, 30-B 449.

The author reports 17 cases of pathologic dislocation of the hip—a short leg and a limp—observed at varying ages of childhood and adolescence. Fourteen of these patients have been traced and re-examined.

Among these 17 cases reconstruction of the Colonna type was performed in 1 case, subtrochanteric osteotomy was done in 4 cases, and arthrodesis of the hip in 11 cases. 1 patient was not treated surgically.

The patients were followed for a period of 10 years after operation. Subtrochanteric osteotomy was done in 4 cases with success in only 1 case. In the cases in which subtrochanteric osteotomy was performed as a secondary operation the results were excellent. In 1 case arthroplasty was attempted at the age of 8 years with failure. The best results were obtained with arthrodesis of the joint which gave a stable, strong and painless hip. Among 11 patients so treated, good bone fusion was secured in 7. Union occurred in all 4 patients who were operated upon after the age of 12 years while only 3 of 7 patients operated on before the age of 9 years obtained satisfactory fusion.

The author believes that arthrodesis should be delayed in cases of this type until the age of 12 or 13 years. Only 1 patient in the present series complained of pain in the back after arthrodesis. Shortening is combated by bringing the trochanter down as nearly as possible to its normal level.

RICHARD J. BENNETT, JR., M.D.

#### Ununited Fractures of the Neck of the Femur JAMES A. DICKSON, *J. Am. M. Ass.* 1948, 137 1199

In spite of the increased number of united fractures which internal fixation has yielded from 35 to 50 per cent of intracapsular fractures of the femur are functionally unsuccessful.

The present article is devoted to a study of ununited fractures. From the findings in this study it seems possible to restore anatomic and physiologic function to the hip joint. Once nonunion is recognized, the earlier the operation is performed the better will be the results. An understanding of the basic principles of causation makes earlier recognition and rational repair possible.

The mechanical factors of the angle of the fracture and of circulation are most important. Fracture lines which tend towards the vertical not only inhibit union by shearing action, but facilitate aseptic necrosis by depriving the femoral head of contact with the medullary circulation.

The aim of treatment then must be to secure impaction at the fracture line and to re-establish circulation to stimulate osseous repair.

The numerous techniques involving one or the other of these principles are critically reviewed and failure of operation occurred in from 35 to 50 per cent of all the cases in this category. The author presents his technique of a controlled high osteotomy which changes the inclination of the fracture line from about 65 degrees to less than 30 degrees. A bone graft from the ilium is added to aid in revascularization and osteogenesis. The procedure has yielded solid union with equalization of leg length in 9 out of 10 patients operated upon.

Conservatism is urged in handling the dead femoral head since such heads may become re-

vascularized and functional if weight-bearing is prohibited while regeneration is taking place. Perhaps a more careful selection of the primary procedure in these fractures might reduce the incidence of non union, and surely the earliest possible surgery must be undertaken when nonunion is known to exist as waiting permits degenerative changes which militate against a favorable outcome.

FRANCIS E. BROWNIECKE, M.D.

**Trochanteric Fracture.** MATTHEW CLEVELAND D M BOWORTH, and F R THOMPSON. *J Am Med Ass* 1948, 37: 86.

The concept that the trochanteric fracture is a simple one to handle and always will give a good result is erroneous and disregards the frequent sequelae of disability and discomfort which often plague patients with this condition for life. A study of 133 consecutive cases observed at St. Luke's Hospital, New York shows that the lesion is not simple and does not routinely come to a good result.

The average age of the patients is more than 75 years and 90 per cent of them are women. Commonly they have numerous physical mental or both types of changes in addition to the fracture so that they are not "good risks" for any care.

The injury initiating these fractures is usually slight, the result of stumbling or a slight fall but often dissolution of the bony structures prior to the injury is really the cause of fracture. The response to rapid and definitive treatment for relief of pain and spasm is good if procedures are carried out rapidly and the patient is well supported.

The choice of treatment depends on the ability and experience of the medical personnel as well as on the type of trochanteric fracture. However the various levels at which fracture occurs influence the treatment less than they do the end result and the length of time required to secure union. Modes of conservative treatment are reviewed and of them, Russell's balanced traction is recommended over any other than internal fixation when that can be competently carried out.

A survey of 133 consecutive cases with 93 per cent follow-up was conducted. A group of 38 patients treated by balanced traction was compared with a group of 95 patients treated by internal fixation. The numerous complications arising in spite of excellent hospital care of the "traction" patients led to the trial of internal fixation with a Jewett type of nail made of vitallium. With nails of assorted angles and lengths at hand and a speedy surgical and roentgen team for accurate rapid work, the results were good.

Postoperatively light traction is maintained temporarily followed by a Thomas brace with pelvic band and knee lock. Crutch ambulation with minimal weight bearing is permitted early but the brace must be worn until union is solid. This takes from 3 to 7 months.

Complications occurred but less frequently than in the traction-treated group. The most annoying

complication was gradual progression of the nail through the femoral head and into the acetabulum. Too long a nail and early or too active weight bearing predispose to this complication. The symptoms are minimal, and removal of the nail has been done readily and without further complications.

Conservative care netted a hospital mortality of 36 per cent, while in the operative group of patients it was 13.6 per cent. Senile psychosis occurred in 11 per cent of the "traction" patients and in only 2.1 per cent of those subjected to nailing.

The survival rate of these patients is not high in any case but 1 year after fracture, 32 per cent of the group treated by traction and 73 per cent of those subjected to nailing were alive. After 4 years the survivals were 13 per cent and 30 per cent, respectively. Now all intertrochanteric fractures are nailed according to this technique.

FRANCIS E. BROWNIECKE, M.D.

**Treatment of Pertrochanteric Fractures** (Zur Behandlung der pertrochanteren fracturen) H. B. OTTEN and W. J. PROFFERT. *Helvet. chir. acta*, 1948, 15: 509.

The present treatment of pertrochanteric fractures by extension for several months or by the application of a plaster cast is a difficult experience for the patient who is usually old. It also entails much time and some care. Therefore the authors have used internal fixation of the fracture by passing several Kirschner pins through the skin and the fragments in the following manner.

After preparation of the skin the patient is placed on the orthopedic table and the fracture is carefully reduced. Special attention is given to the correction of external rotation. The soft tissues lateral and caudal to the trochanter are anesthetized. To determine the direction of the pins during their insertion, a wire screen (anteroposterior direction) a water level and a protractor (axial direction) are used. After the first two or three pins have been inserted, roentgen films are taken in the anteroposterior and axial directions. If one of the pins is in the correct position, the direction and depth of penetration of the others are patterned accordingly. Further control films are taken and the necessary corrections made after each insertion of three pins. Good position of the pins in the axial direction is usually the greatest problem. An effort is made to place the pins so that their whole course lies inside the femoral neck. Any pin that pierces the articular cartilage is pulled back to a subchondral position. The arrangement of the pins and their number depend on the fracture and especially on the size of the lateral spur of the shaft fragment. Usually from 6 to 8 (rarely 10) pins are used. In intertrochanteric fractures, or in cases in which the fracture line runs, without strongly lateral convexity from the tip of the great trochanter to the lesser trochanter, the pins are inserted convergently up to the femoral head. The shorter the spur the more caudal the insertion of the pins on the femoral shaft and the steeper their

course. The pins are often allowed to cross one another. The portion of the pin which protrudes through the skin is cut off as deeply as possible while an assistant depresses the soft tissues with two flat instruments. A dry dressing is applied and the leg is kept between sandbags for 14 days, when slight active movements may be started.

This method was used in 33 cases during the last 2 years. The majority of patients were women in bad general condition, 9 of them were between 70 and 88 years old, to avoid pulmonary and cardiovascular complications the insertion of pins was performed frequently on the second or third day and even immediately after admission. Movements in bed were started after from 4 to 15 weeks (average, 8 weeks) and the patients were taken out of bed and began to use the extremity after from 10 to 27 weeks (average, 14 weeks). In several cases the pins were removed before the extremity was used (average, 13 weeks) because they were about to pierce the skin. Healing occurred in all cases despite severe senile osteoporosis in many of the patients. Loosening of pins occurs rarely and never to such a degree that the roentgen picture shows clearing around the pin. One case was observed in which the faulty insertion of the pins led to heat damage of the bone, thus demonstrating the danger of the use of drills and circular saws in bone surgery. RICHARD KEMER, M.D.

**Aseptic Necrosis of the Femoral Head** CARL E. BADGLEY and R. H. DENTAM *J Am Med Ass* 1948 137 1193.

The term "aseptic necrosis" has been too loosely used to make comparable studies of end results so classified and various phases of degenerative arthritis. Avascular necrosis may be used more specifically to define death to part or all of the femoral head due to vascular damage primarily of the posterior and anterior circumflex femoral vessels.

Although the bone necrosis quickly follows severe vascular damage it cannot be demonstrated (by its relative density) roentgenologically for from 2 to 3 months. Subcapital and transcervical fractures are suspects of avascular necrosis particularly when manipulation or open surgery upon the capsule further jeopardizes the supply of blood to the femoral head.

The frequency of avascular necrosis in fractures in which internal fixation has been followed by bony union is rather high about 40 per cent in one study. Although the internal fixation itself does not produce avascular necrosis it does produce a high per cent of united fractures in spite of a dead femoral head.

Four main types of complications are noted in the process of repair of fractures of the femoral neck.

1. Bony union with a period of functional use followed by pain, roentgen changes in density and contour of the femoral head from collapse of the weight bearing surface. The term aseptic necrosis should be restricted to this entity.

2. Bony union followed by decreasing function, pain, loss of joint space but maintenance of the con-

tour of the femoral head. To this state the term degenerative arthritis may be accurately applied.

3. Nonunion of the fracture may be associated with a dead head.

4. Nonunion of the fracture in the presence of a viable head.

Phemister's contributions to the clinical and pathologic knowledge of these complications are reviewed, and a résumé of the means of avoiding unnecessary damage to the vascular supply is offered. Of major importance is avoidance of weight-bearing until the viability of the head and union are ascertained with roentgenograms. In spite of careful treatment, avascular necrosis is a serious complication which may result in a poorly functioning hip.

Choice of operative therapy depends upon the degree of degeneration and the type of patient chiefly and ranges from a vitallium mold arthroplasty to arthrodesis of the hip. Various reconstruction operations are useful in certain instances and in experienced hands.

FRANCES E. BREXIDECHE, M.D.

**Surgical Treatment of Uncomplicated Knee Dislocation** (*Traitement chirurgical des luxations non compliquées du genou*) BASTIEN and VANHELLE. *Lille chir* 1948 14: 53.

In appropriate cases early surgery in dislocations of the knee is advisable. It permits thorough evacuation of the hemarthrosis and tears of ligaments, capsule and muscles can be explored and repaired. The meniscus can be resected partially or completely, if necessary. Furthermore in cases in which reduction is impossible because of interposition of parts of the capsule between the articular surfaces, open reduction is imperative. Effective repair of the cruciate ligaments is, in most cases, impracticable and unnecessary. The authors suggest removal of the torn portions without suture of the cruciate ligaments. Perfect suturing of the lateral ligaments to insure the greatest stability of the joint is important. Surgery should be performed within 4 or 5 days after injury.

The approach to the different ligaments and the technique of operation are discussed in detail. For repair of the internal lateral ligament the authors suggest a horizontal incision a little superiorly to the joint, which is continued proximally and posteriorly in a vertical direction. This approach exposes the ligament in its entirety and at the same time permits perfect exploration of the joint. The branches of the saphenous nerve are spared by this incision and no sensory disturbances are observed postoperatively. The external lateral ligament is exposed by an oblique straight incision beginning at the condyloid tuberosity and ending at the head of the fibula.

For exposure of the cruciate ligaments different techniques are employed. The authors prefer the transtuberous route for the anterior ligament and part of the posterior ligament. A U-shaped incision is made, the horizontal portion of which crosses a little inferior to the tuberositas tibiae. The tuberosity is dissected and the patella and patellar liga-



ment are turned upwards this permits wide exposure. The inferior insertion of the posterior cruciate ligament is approached by a vertical incision in the popliteal space between the semimembranosus and gastrocnemius.

In old or neglected cases symptoms of instability and muscular atrophy may be present. Arthroscopy may reveal lesions of the menisci and cruciate ligaments. In these old or neglected cases suturing of the ligaments is not successful and autoplasmic operations with the use of tendons must be performed.

WERNER M. SOLMITS, M.D.

### ORTHOPEDICS IN GENERAL

**Total and Subtotal Sacrococcygeal Agenesis (Agrosacros coccygea, totalia y subtotales)** JOSE M. JORON and HECTOR JORON. *Rev. A. med. gen.* 945, 62-350.

The authors review 9 cases of total and 27 cases of subtotal sacrococcygeal agenesis reported in the world's literature. They add one case of their own, that of total absence of the sacrococcygeal segment, the clinical history of which has been followed for a period of 20 years.

The boy was first seen at the age of 4 and at this time the condition was diagnosed as congenital absence of the lumbosacrococcygeal segment. There was a gibbus formation in the lumbosacral articulation to which the aponeurosis and ligaments were attached. Twelve years later the boy was able to get about dexterously on crutches, and had grown, although he was small of stature for his 16 years. His chest and arms were large and well developed, whereas his waist, hips, and legs were atrophic and of the paralytic type. There was complete incontinence of urine and for the most part absence of any sensation of defecation.

The patient was examined periodically from 1938 to 1947 the various changes were recorded and the roentgen ray views were compared.

STEPHEN A. ZIEGLER, M.D.

**The Nutrition of the Articular Cartilage and the Formation of the Synovial Fluid under Various Functional Conditions. Experimental Research on Rabbits with Concurrent Observations on the Compressibility of the Articular Cartilage With and Without a Fluid Supply Approaching Physiologic Conditions (Ueber die Ernährung des Gelenkkorpels und die Bildung der Gelenksflüssigkeit unter verschiedenen funktionellen Verhältnissen. Eine experimentelle Untersuchung an Kaninchen unter gleichzeitiger Berücksichtigung der Kompressibilität des Gelenkkorpels bei bzw. ohne Flüssigkeitszufuhr)** BOE. E. WOLMARK and JOSEF SÄLLER. *Acta physiol. scand.* 945, 7-303.

Experiments were carried out on 40 (8 months old) rabbits. Both shoulder joints were used, the right and left shoulders being scattered throughout the various groups without reference to right and left sides and without regard to the individual ani-

mal. However, a number of these shoulders were used as controls in the various manipulations involved so that only about 60 of these joints were employed in the true study. With the exception of one living control rabbit this work was done on killed animals. The total material was divided into 4 groups. In every case the removed shoulder joint was encased up to the cartilage in Wood's metal, and mounted in an apparatus, constructed by Ingelman, for measuring the compressibility (changes in thickness in the cartilages). In every case the blood was washed out of the experimental field by a perfusion fluid (dextran) which was developed by A. Groenell and B. Ingelman (*Acta physiol. scand.* 1944, 7, 97-1045, 9-12) and which is used extensively in local medical practice as a substitute for blood serum. For histologic examination the tissues (cartilage, capsule, synovia, joint fluids) were mounted on smears or sections stained with iodine in a solution.

In the first group of experimental animals the arteries leading to articular regions was perfused with dextran containing a suspension of rice starch granules (about 1,000 granules per cubic centimeter). In this group the starch granules were later found distributed in the articular cartilage about three-fourths of them in the basal third, a fourth in the middle third, and none in the upper third of the cartilage; that is, the third adjoining the joint cavity.

In the second group the starch suspension was suffused into the marrow cavities adjoining the scapular and the humeral articular cartilages. Here one-half of the granules were found distributed within the basal third, a third within the middle, and a sixth within the superficial third of the thickness of the cartilage.

In the third group the procedure was the same as in the second except that during the injection into the marrow cavity the joint surfaces were repeatedly pressed together and as often the pressure released, attempting in this manner to imitate the vital function of the joint during the life of the animal. In these joints, about one-fourth of the starch granules were later found distributed within the basal and middle thirds respectively while the other half of the granules were distributed in the superficial third of the cartilaginous thickness.

In the fourth group the treatment was the same as for the third group, except that the medullary cavity was perfused with the dextran, without the starch granules, and before the start of the experiment 0.5 c.c. of the suspension of rice starch was injected into the articular cavity through the articular capsule. Here the cartilage was later found to be devoid of starch granules, except in a few instances in which there were a few granules in the superficial layers of the cartilage.

In this last group an interesting finding was the greater number of granules per volume unit of cartilage substance in the cartilage of the glenoid cavity than in that of the humerus. This is explained by the authors on the assumption that the starch granules would find greater difficulty in penetrating that

part of the cartilaginous substance comprising the cellular tissues in the rabbit the glenoid articular cartilage has been shown to have a lesser cellular content than that of the humerus. On the whole there were more starch granules per unit of volume in the cartilages of the third group than in the others and this is interpreted as due to the greater perfusion of fluid through these cartilages from the functional strain put on them during the experiment.

With regard to the effect on the amount of synovial fluid as a result of experimental manipulations no method was found to measure accurately the amounts of joint fluid present however the impression was that the physiological stress put on the joint resulted in an increase in the amount of joint fluid present. The fluid in the first and second groups did not contain starch granules. In the first group granules were found in the capillaries of the synovial membrane and this finding is thought to demonstrate the presence of anastomoses between these capillaries and the vessels of the medullary cavity. In the third group there were no granules in the synovial capillaries and therefore it is thought that those found in the synovial fluid passed from the medullary cavity into the cartilage and from there into the joint cavity.

In the second group the cartilage was found to increase in thickness soon after medullary perfusion was started and this is regarded as a result of the replacement from the medullary cavity of the fluid loss sustained during the period between the killing of the animal and the starting of the perfusion. This swelling phenomenon was even more pronounced in the third group and seems to postulate an increase in the fluid circulation in the cartilage under physiologic stress. This fact together with the tendency of the cartilage to resume its initial volume following the compression (this tendency being stronger in the joints with medullary perfusion) suggests that the conditions under which these experiments were carried out closely resemble those present during life and that the results obtained would apply closely to those obtained in the living subject.

JOHN W. BRENNAN, M.D.

**Experimental Research for Promoting Longitudinal Growth of the Lower Extremities by Irritation of the Growth Region of Femur and Tibia.** G. CHAPPEL and J. ZELDENRUST. *Acta orthop. scand.*, 1948, 17, 371.

Shortening of one of the lower extremities may occur after poliomyelitis, joint destruction in childhood malunited fractures, congenital hypoplasia and other affections. In the treatment of adults there are two methods of correction—either lengthening the short extremity or shortening the longer extremity—or an elevated shoe may be prescribed for the shortened extremity. Elongation of the shortened extremity is the most logical procedure but its application is rather limited and it is frequently attended by complications. Shortening of the normal limb presents certain technical and physio-

logical difficulties. One of the most successful operations is that of epiphyseodesis described by Phipps, which arrests the growth of the longer limb.

When the epiphyseal cartilage of the shorter limb is intact, it is possible to stimulate the growth. Various efforts in this direction have been described by Stanley, Paget, von Bergmann, von Lagenbeck, Hellerich, Helger, Königswieser, Riedinger, Weinlechner, Schott, Rauch, Schüller, Reschke, Ruschenberg and others. Ollier was the first to propose a correction of genu valgum by one-sided destruction of the epiphyseal cartilage. Roentgen therapy has been used in attempts to arrest bone growth; however the authors consider that this may be harmful.

In the authors' experiments bone growth has been stimulated by inserting ivory pegs into the metaphyses of growing bones of animals. They state that this lengthening is minimal and is not suitable for human practice on account of its uncertainty and because of resulting deformities. Phemister's epiphyseodesis or the Hass wire-loop growth restraint is preferable.

DANIEL H. LEVINTHAL, M.D.

**Sciatica Caused by Herniation of Intervertebral Disc. Late Results of Operation in 115 Cases (Les sciatiques discales. Résultats éloignés de 115 cas opérés).** DECOULX and SOULARY. *Lille chir.* 1948, 16, 137.

The author discusses the symptomatology, diagnosis and treatment of sciatica caused by herniation of an intervertebral disc, and reports the late success of surgery in 107 of 115 cases.

Only about 30 per cent of the patients remember a gross injury like heavy lifting or a fall as the cause of their complaints. In most cases the affection starts with repeated attacks of lumbago of several days' duration, and only gradually the picture of sciatica develops in the subsequent months or years. The Lasègue sign is practically always present; other typical signs are rigidity and scoliosis of the lumbar spine, often combined with kyphosis and torsion so-called cork-screw rachis, muscular atrophy, hypesthesia and diminution or absence of the Achilles reflex. Ninety per cent of all nuclear hernias are located either between the fourth and fifth lumbar vertebrae or between the fifth lumbar and the first sacral vertebrae. The following signs are used to differentiate between the two locations:

**Herniation between fourth and fifth lumbar vertebrae.** Normal Achilles reflex, atrophy of buttocks, thigh and calf, hypesthesia of the anterior malleolar region, dorsum of foot and great toe.

**Herniation between fifth lumbar and first sacral vertebrae.** Absence of Achilles reflex, atrophy of anterior lateral leg muscles, hypesthesia of posterior malleolar region, sole and heel.

This differentiation is, however, rather theoretical and not too dependable.

The roentgenogram reveals characteristic pictures only in a minority of cases (38 cases in the authors' series of 115). Injection of a contrast substance in the spinal canal should be considered only in excep-

tional and atypical cases when all other diagnostic methods have failed. Severe headaches, aggravation of pain fever and even more serious accidents have been reported after such myelography. If it is unavoidable to inject a contrast substance, some material which is more fluid than lipiodol should be injected and aspirated after roentgenography.

Surgery is indicated only in severe and refractory cases after medical treatment has failed. The medical treatment consists in complete bed rest for 1 month and radiotherapy.

The operation can be performed either by laminectomy or by the lateral approach. The former method gives ample exposure but is not without danger and has been abandoned by the authors after severe complications in 2 cases—in 1 case a local postoperative pachymeningitis, in the other a paraplegia which, a second intervention showed, was caused by a hematoma pressing on the medulla. The lateral approach (extraction of the herniated disc after resection of the ligamentum flavum) does not require opening of the meningeal sac and is technically not difficult. The operation does not take more than 15 to 45 minutes. In most cases one finds the sensory root stretched over the disc like a violin string. In other cases the disc protrudes with out being herniated and has to be extracted with forceps. In still other cases, nothing abnormal can be found. In these cases either the herniation cannot be visualized, or the complaints have been caused by vertebral periarthritis or by hypertrophy of the ligamentum flavum rather than by a slipped disc. Here the surgeon can either resect the sensory root or, as the author prefers, liberate the root over a large area.

The superiority of the lateral method of approach is well illustrated. Laminectomy resulted in com-

plete cure in 69 per cent of the patients as compared with 92 per cent complete cure with use of the lateral approach. Furthermore, with laminectomy the herniation could be visualized in only 39 per cent of the patients, while in the lateral approach, herniation could be visualized in 84 per cent.

WERNER M. SOLMITS, M.D.

**The Bone Marrow on Sternal Aspiration in Multiple Myeloma.** EDWIN D. BAYRD. *Blood*, 1944, 3: 937.

This study of the bone marrow on sternal aspiration in multiple myeloma is concerned primarily with three main points: (1) the type of cell or cells involved in the production of the disease; (2) the origin of this cell or these cells; and (3) cytologic criteria for the degree of malignancy.

The author gives a broad summary of the literature in regard to the first two headings, but finds very little on the third.

He has analyzed the sternal marrow biopsies in 71 cases at the Mayo Clinic. Differential counts and morphologic details were studied completely in 51 cases and 43 cases had been under observation long enough to attempt correlation between the abnormal cellular structure and the degree of malignancy which was present.

All 71 cases were classified as falling into the plasma cell type of multiple myeloma. In the series he can trace all gradients from the normal plasma cell to the most anaplastic and immature myeloma cell. He believes the common origin of the cells is in the reticulum.

The study tends to substantiate the theory that the more abnormal the diseased cells, the greater the degree of malignancy.

KENNETH H. SPONDEL, M.D.

# SURGERY OF THE BLOOD AND LYMPH SYSTEMS

## BLOOD VESSELS

Contribution to the Biochemical Study of the Phlebitides and Their Surgical Treatment (Contribution à l'étude biochimique des phlébites et à leur traitement chirurgical) ROBERT FORTADRE, PAUL MANUEL and GEORGES APPRILL. *J internal chir. Brux.* 1948 8 778.

To prevent or abort a phlebitis it is not sufficient to lower the prothrombin level by dicoumarin or to prolong the coagulation time by heparin since despite the use of these anticoagulants, venous complications occur or continue their course. In these cases the authors have always found Lenggenghager's time (reaction of the thrombin level) shortened revealing a hypercoagulability which persists despite a prothrombinemia that has been greatly lowered by dicoumarin. Everything proceeds as if there were an excess of thromboplastin. Therefore the authors think that there are phlebitides with hyperthrombinemia, and others with hyperthromboplastinemia. As a result the biochemical control of the phlebitides should not be limited to investigations of Quick's time of the prothrombin level or of the coagulation time, but these examinations should be completed by the systematic study of the platelet level and Lenggenghager's reaction.

The therapeutic failures of the anticoagulants demonstrate that surgical treatment has a place in the therapy of the phlebitides. Embolic phlebitis should be operated upon to stop emboli.

The authors have operated upon 3 patients who had one or several previous small emboli through a small femoral or iliac phlebotomy they were able to remove long floating and only slightly adhering clots and thus to re-establish blood flow in the veins. One was complete without sequelae, 18 months later.

In adherent thrombophlebitis of the phlegmasia alba dolens type the danger of embolism is not as great as that of late sequelae. Operation reveals clots which adhere rapidly and intimately to the venous wall. In 3 (of 5) patients operated upon thrombectomy was performed but was incomplete in 1 case and the course of the phlebitis was unchanged, in the other 2 cases the veins were completely freed from clots and the edema regressed rapidly these 2 patients died later and at autopsy the veins were found to be without new thrombosis.

Two other patients were phlebectomized one of these died of shock and the other was cured.

Eight patients were operated upon for old phlebitis which had been present for periods of from 6 months to several years. In 3 of these the veins were freed and periarterial sympathectomy was performed but the results were unsatisfactory. Of the other 5 patients complete phlebectomy gave excellent results in 3 and incomplete phlebectomy

(in 2) gave slight improvement in 1 patient and resulted in failure in the other.

Iliofemoral phlebectomy was done for effort phlebitis with arterial spasm in 1 case and femoral phlebectomy was done for suppurative phlebitis in another with excellent results.

Simple ligation and especially of the inferior vena cava is indicated only in embolic phlebitis this is an emergency operation having no other object than that of preventing embolism. Thrombectomy is better since it eliminates the sequela of phlebitis it is the method of choice for all varieties of phlebitis and gives the best late results. If it cannot be done phlebectomy of the entire thrombosed segment should be performed. RICHARD KEMEL, M.D.

Surgery of Arterial Injuries and the Problem of Vein Transplantation (Ueber die Chirurgie der Arterienverletzungen und die Frage des Venentransplantats) KARL BAETZNER. *Chirurg* 1947 17-18 345

The author reports experiences in surgery in about 300 cases of arterial aneurysm most of them due to gun shot injuries. The cases were observed in the surgical department of the University at Freiburg Germany.

He emphasizes the dangers of ligation of large arteries especially the carotid and the popliteal. Ligation of the popliteal artery leads to gangrene in from 30 to 80 per cent of the cases according to different statistics. Also ligation of the anterior tibial artery may lead to gangrene of the foot, even when the posterior tibial artery is in good condition. Ligation of the common carotid artery causes cerebral disturbances, hemiplegia or death in from 30 to 50 per cent of the cases.

Therefore in two-thirds of his cases the author preferred reconstructive methods to ligation. End-to-end suture after extirpation of the aneurysm is possible only in smaller injuries. Often the adjacent parts of the arterial wall, proximal as well as distal to the aneurysm are damaged for a length of several centimeters so that sutures do not hold and direct suturing is impracticable. On the other hand if larger portions of the artery are resected and the stumps joined under tension the diameter of the vessel decreases considerably and insufficient peripheral circulation ensues.

In about one-half of the cases transplantation of a vein was done successfully. It could be shown by arteriography that in a high percentage of the cases the grafts remained patent. In 1 case it was possible to examine the graft histologically 22 years after the transplantation. The wall of the grafted vein had changed to an arterylike wall and even showed typical arteriosclerosis.

Usually the long saphenous vein is used for transplantation. However frequently the lumen of

this vein is not wide enough especially for grafts in large arteries like the subclavian common carotid external iliac, and femoral. In these cases, it is preferable to use the femoral vein. As the collateral circulation is very well developed in the venous system even portions of from 15 to 20 cm. in length can be taken without danger of circulatory disturbance. In arteriovenous aneurysms vein from the surrounding region can be taken in some cases. However often in aneurysms of the subclavian and carotid arteries the veins are very thin and friable so that they are not fit for grafting.

WALTER M. SOLMITZ, M.D.

**Resection of the Femoral Artery in Circulatory Disturbances of the Leg** (*Die Resektion der Arteria femoralis bei Durchblutungsstörungen am Bein*)  
 L. B. BERNHARD. *Chir. wch.* 1918, 9, 93.

The author believes that in circulatory disturbances of the leg especially in thrombosis and aneurysm of the femoral artery, resection of the artery is the method of choice. In contradistinction to other large arteries of the body, the femoral artery often becomes obliterated in its entire length after a locally circumscribed lesion. This can be demonstrated by roentgenography. Frequently one can observe that in thrombosis of one artery, circulatory disturbances, pain, and coldness develop also in the contralateral leg. After resection pain and circulatory disturbances cease in the contralateral leg first immediately after the operation, and only much later in the extremity subjected to operation. The mechanical obstruction of the artery is not the only cause of the circulatory disturbance. Irritation of the arterial wall leads to vasoconstriction of the blood vessels and to lesser degree of the contralateral leg and may also cause other disturbances of the entire sympathetic nervous system. Therefore, in some cases, lumbar sympathectomy should be added to the resection of the artery.

The operation is most successful in thrombosis and arteriosclerosis, less in arteritis of various origins. In endarteritis obliterans the outcome is less satisfactory, and resection of the lumbar sympathetic trunk should be done in all these cases in addition to resection of the artery. Also in ulcers and threatening gangrene the operation sometimes leads to a successful outcome.

Of the numerous functional tests, continuous rectal temperature proved the most reliable. After a water bath of 15° C. for 15 minutes the leg is put under a heat cradle at 50° C.

The oscillatory index is much less reliable.

WALTER M. SOLMITZ, M.D.

## BLOOD; TRANSFUSION

**Experimental Study with Blood Transfusions** (*Studio sperimentale sulle trasfusioni di sangue*). VITTORIO LAURICELLA. *Arch. Ital. Chir.* 1918, 70:9.

The author conducted an experimental study on dogs, to determine the fate of transfused blood, for which he received the Achille Albanese award from the University of Palermo.

He developed an internal biliary fistula in dogs. At first the gall bladder was anastomosed directly to the right renal pelvis after the common duct had been ligated, but this procedure resulted in a high mortality. He then made the anastomosis through the body of the kidney to the pelvis, and by so doing the mortality was reduced to zero. Eight dogs were operated upon in this manner. Following recovery from the operation the amount of bilirubin excreted was determined daily and a standard was set for each animal. Four dogs were then transfused with compatible blood varying from 50 to 100 c.c. The other 4 dogs were transfused with similar amounts after an amount of blood equal to that to be transfused was first removed. The amount of bilirubin was determined as previously.

From the results of these experiments, the author arrived at the following conclusions:

1. The blood transfusions were constantly followed by an increase in the bilirubin excreted. This increase began within 24 hours and lasted for variable length of time up to 20 days—an average of 15 days.

2. Blood-letting previous to the transfusion did not influence the amount of bilirubin excreted.

3. The amount of bilirubin excreted in excess of normal was proportional to the amount of blood transfused.

4. The post transfusion hemolytic phenomena of which the excess of bilirubin excreted constitutes a direct index, are proportional to the quantity of blood transfused, and indicate the destruction of an amount of blood equal to that transfused.

The destruction of transfused blood cells does not represent a normal cycle for red blood cell destruction. In the experiments, the transfused blood is apparently destroyed within 20 days, an average of 15 days for the 8 dogs. The bilirubin excretion level then returned to normal. According to the experimental work of Hawkins and Whipple as well as others, the life cycle of red blood cells in dogs is about 124 days, and hence represents a much longer period than the life cycle of transfused red blood cells, as these experiments would seem to indicate.

LEONARD J. FROST, M.D.

# SURGICAL TECHNIQUE

## OPERATIVE SURGERY AND TECHNIQUE POSTOPERATIVE TREATMENT

Prothrombin Activity RACHEL S. SANDROCK and  
EARLE B. MAHONEY *Ann Surg* 1948, 128 522

Postoperative prothrombin activity was studied in 382 surgical patients. In this series 80 per cent of the patients did not show any signs of hyperprothrombinemia in the blood and did not give any evidence clinically of thromboembolism. In the remainder hyperprothrombinemia was detected before the onset of clinical signs of thrombophlebitis.

The authors found that in the first 3 days of recovery after operation an increase of prothrombin activity in the blood became the precursor of thromboembolic phenomena in the patient. Dicumarol was administered prophylactically to 23 patients because of the sudden increase in prothrombin activity.

The authors thought that the dilution prothrombin test was too variable; therefore the prothrombin activity of whole plasma was used for the test.

It was often found that when clinical signs of thrombosis were present prothrombin activity in the blood was already reduced or normal. It was thought that the hyperprothrombinemia discovered on the third postoperative day manifested the onset of thrombosis in the small veins of the leg. The test was not considered accurate for all cases because not every patient with hyperprothrombinemia developed clinical thrombosis.

BENJAMIN G. P. SHATTROFF, M.D.

## ANTISEPTIC SURGERY: TREATMENT OF WOUNDS AND INFECTIONS

Traumatic Lesions of the Thumb of Recent Origin  
(Lesiones traumáticas recientes del pulgar) PEDRO  
V. FLEDMONT. *Am. J. Orth. Surg.*, 1948, 1 97

Of three functions of the hand—exploration of the objects, gestulation, and exertion of pressure—the last mentioned is the most important. The thumb is of greatest value for exerting pressure.

The author makes a plea for conservative surgical treatment of traumatic lesions of the thumb illustrating the description of various methods by examples from his own practice.

A poor stump is preferable to a complete loss of the thumb because it may be reconstructed. Various plastic procedures may transform a useless thumb into a useful organ.

In a complete avulsion of the soft parts there is a general tendency to place the torn tissues back into their original position and to suture them. However, the late results of such treatment are very unsatisfactory due to necrosis of the skin. The author prefers to treat traumatic lesions by debridement, proper immobilization, and replacement of the injured

tissues by a skin flap preferably taken from the abdomen at a later date. After transplantation the injured arm is placed in a body cast.

If a bone is crushed a subperiosteal extirpation is recommended.

The author advocates lavage of the wound with copious amounts of an antiseptic solution. In very extensive injuries if the tendons cannot be identified and properly sutured at least an effort should be made to preserve the nerves to avoid an annoying anesthesia. As a rule the cast is removed after from 6 to 8 weeks.

If an extensive defect of the skin is present one of three methods may be employed: (1) the wound may be allowed to heal by second intention; (2) it may be sutured; or (3) a plastic repair may be performed. The first two methods are condemned because they produce painful scars.

Loss of the distal phalanx is estimated to cause 10 per cent disability; loss of the proximal phalanx 30 per cent; and loss of the thumb including the corresponding metacarpal bone 35 per cent.

JOSEPH K. NARAT, M.D.

Suppurative Fasciitis as the Essential Feature of  
Hemolytic Streptococcus Gangrene. E. L. MC  
CAFFERTY, JR., and CHAMP LYONS. *Surgery* 1948  
23 438.

The term "necrotizing erysipelas" was introduced to designate a specific infection due to beta hemolytic streptococci, and characterized by subcutaneous necrosis and secondary cutaneous gangrene. Early surgical incision to the limits of the subcutaneous necrosis were demonstrated to be effective in the control of the spreading infection.

The clinical picture of the disease is well known. It most commonly affects the extremities. The pathognomonic sign of the disease has been described as a dusky line of the skin with or without blisters or bullae and usually appearing on the third, fourth or fifth day of the infection. Before potent antistreptococcal therapy was available, multiple incisions of the bear-scratch type were lifesaving. The wounds were then dakinized and the considerable defects pinch-grafted 6 to 8 weeks later.

The authors present certain modifications in our understanding of this disease as a consequence of their experience with penicillin-treated infections. The conclusion that the disease was an anaphylactic phenomenon of the Schwartzman or Arthus type has been brought forward. In studies of penicillin-treated infections the subcutaneous necrosis has been limited quite clearly to a suppurative fasciitis. Hemolytic streptococcus gangrene is an extensive cellulitis which even under modern therapy is frequently complicated by abscesses of the fascial planes.

Recognition of suppurative fasciitis as the essential feature of hemolytic streptococcus gangrene has

simplified its clinical management. The diagnosis and surgical incision should not be deferred for the appearance of the older pathognomonic sign of impending cutaneous gangrene. Recognition of persistent edema along a fascial plane in an infection otherwise subsiding under antistreptococcal therapy is indicative of a fascial plane abscess.

The bear-scratch type of incision has been discarded in favor of planned fasciotomy incisions designed to expose the entire length of the fascial plane abscess. The most effective method of avoiding long incisions is early recognition of fascial plane edema and prompt surgical intervention. After drainage a fine mesh gauze is introduced into the wound and the extremity is immobilized by a gentle pressure dressing.

Early secondary closure of these frequently considerable defects has proved practical and desirable.  
HARRY W. FINE, M.D.

**Antibiotic Therapy** EMANUEL APPELBAUM and WILLIAM A. LEFT *J. Am. Med. Ass.* 1948, 38, 9.

The authors have frequently observed that during the course of treatment with an antibiotic a complete change in the bacterial flora may occur. The pathogenic organisms that are sensitive to an antibiotic in use disappear or become less numerous and insensitive organisms may appear in large numbers and cause a new infection. The authors reported in great detail a case of pneumococcal pneumonia treated with penicillin, in which there developed a new infection due to gram negative bacilli which responded to streptomycin. They strongly emphasized the occurrence of superinfections as an important and hitherto poorly appreciated feature of antibiotic therapy in general. The importance of frequent and careful bacteriologic examinations in all patients before and during treatment with an antibiotic was stressed in order to detect the presence of superinfections.

The authors do not, however, advocate the combined use of two different antibiotics from the start of treatment of infections because first, these drugs may sensitize certain patients to their use later in life and, secondly, the incidence of the occurrence of superinfections does not appear to be high enough to warrant such a practice.  
ROBERT TURELL, M.D.

**Penicillin Therapy** N. ERCOLI, W. C. HUEPPE, L. LANDAU, B. S. SCHWARTZ, and F. J. QUAKER *J. Am. Med. Ass.* 1948, 38, 5.

During the past few years there have been numerous investigations conducted with a view to the development of a simple and efficient method for maintaining and prolonging an effective blood level of penicillin culminated in the development by Romanak of a penicillin-wax-oil mixture but because this preparation has a high melting point and viscosity requiring special syringes, and in view of the occasional occurrence of painful indurations at the site of the injection, there arose a need for the development of an injectable preparation of penicillin which can be

handled at ordinary room temperature and which does not produce appreciable untoward reactions while possessing superior therapeutic properties.

The observation that small doses of epinephrine suspended in oil exert a strong delaying effect prompted Ercoli and his collaborators to incorporate potassium penicillin into a vehicle of this composition. The quantity of epinephrine added to the oil was kept sufficiently low to assure a prolonged local vasoconstrictor action without causing any systemic vasopressor effect. The authors presented evidence to show that their mixture of 300,000 units of potassium penicillin, 0.3 mgm. of epinephrine, and 1 c.c. of vegetable oil produces after the intramuscular injection and particularly after the subcutaneous injection, an effective blood penicillin level for periods of 16 to 24 hours. This preparation is easily handled with syringes and needles which ordinarily are available.  
ROBERT TURELL, M.D.

**Aureomycin.** MORTON S. BRYER, EMANUEL B. SCHWARTZ, CAROLINE A. CHANDLER, ELEANOR A. BERN, and FREDERICK H. LONG *J. Am. Med. Ass.* 1948, 38, 117.

Aureomycin is a new antibiotic and is derived from a strain of *Streptomyces aureofaciens*. It possesses bacteriostatic and bactericidal activity against numerous gram positive and gram negative bacteria. It is supplied in acid solutions having a pH of 4.5. The activity of the antibiotic deteriorates rapidly in alkaline solutions at room temperature. Human serum also decreases its activity. The L.D.<sub>50</sub> (lethal dose for 50 per cent of test objects) on intravenous injection in mice is between 50 and 100 mgm. per kilogram of body weight. The L.D.<sub>50</sub> on subcutaneous injection in mice is between 3,000 and 4,000 mgm. per kilogram of body weight. Rapid intravenous injection of 150 mgm. per kilogram of body weight killed a dog and produced hemoglobinuria.

Repeated large doses of aureomycin were tolerated in rats and dogs, with moderate local reaction and some loss of weight associated with anorexia. Autopsy revealed no gross or microscopic abnormality in the viscera. A rabbit tolerated 2 per cent aureomycin borate administered locally in the eye. The concentrations of the antibiotic in serum ranged from 0.3 to 2.4 micrograms per milliliter. The antibiotic was not detected in the spinal fluid. High concentrations of aureomycin were noted in the urine.

Aureomycin administered to mice orally did not protect against infections produced by pneumococcus type 1, or *Klebsiella pneumoniae* type 4, but did protect against those produced by *Streptococcus hemolyticus* beta (C303). Parenteral doses gave some protection against all three infections. Penicillin afforded slightly more protection against infections produced by gram positive bacteria, while polymyxin and streptomycin were superior in experimental infections produced by *Klebsiella pneumoniae*.

Patients suffering from coliform and *Streptococcus faecalis* infections of the urinary tract,

Rocky Mountain fever (Eastern type) typhoid and brucellosis have been treated with aureomycin, which was administered orally or both orally and intramuscularly. The oral dosage employed varied from 10 to 60 mgm. per kilogram of body weight per day given in from 6 to 12 doses. Intramuscularly a total dosage of 3 mgm. per kilogram of body weight per day, divided into 4 doses, was tolerated but with signs of moderate local irritation. The 3 patients with Rocky Mountain spotted fever who were treated on the third to fifth day of their disease were afebrile and asymptomatic within from 12 to 72 hours. A patient ill with chronic brucellosis whose blood cultures were repeatedly positive for *Brucella suis* became afebrile 3 days after the institution of aureomycin therapy. Blood cultures became sterile 48 hours after treatment was begun. As of the date of reporting these had remained sterile and the patient had remained afebrile and asymptomatic for more than 2 months. Infections of the urinary tract due to coliforms and *Streptococcus faecalis* have been sterilized, and evidence of inflammation has disappeared when patients were treated with aureomycin by mouth.

Two patients with typhoid were treated with favorable initial responses.

ROBERT TURELL, M.D.

### ANESTHESIA

**The Role of Epinephrine in Analgesia** E. G. GROSS  
HELEN HOLLAND H. R. CARTER, and EVMICE M.  
CHRISTENSEN *Anesthesiology* 1948, 9, 459.

The potent analgesic agents have been assumed to exert their pain relieving action through a depression of the thalamic region of the central nervous system. The use in various laboratories of improved methods for measuring analgesia however has revealed several indications that the autonomic nervous system may also be involved in the production of analgesia.

It is believed that the results of this study may establish that epinephrine plays a role in the mechanism of analgesia and evidence appears that this may be a vascular effect. Perhaps the vascular effect results in a hypoxic state in the nerve tissue. The exact mechanism however by which a vascular change might bring about the analgesia, and the central or peripheral nature of the analgesia requires further experimentation.

MARY FRANCES POZ, M.D.

**Local Sequelae of Endotracheal Anesthesia** W. ALLEN DONNELLY, ARNOLD A. GROSSMAN, and FRANCIS M. GEM. *Anesthesiology* 1948, 9, 490.

The types of trauma incident to endotracheal anesthesia are discussed and the findings on post-anesthetic indirect (mirror) laryngoscopic examinations in 100 cases are described. Even with residents recently introduced to the endotracheal technique the local damage following intubation was, in all

cases, moderate in degree and caused only minimal subjective complaint or functional change. No permanent damage was encountered.

It is not unreasonable to assume that in the hands of the skilled anesthesiologist, the incidence of trauma resulting from intubation will be minimal and that the occurrence of even slight injuries (noted in this series) will be less frequent. The advantages of endotracheal anesthesia which have not been discussed in this paper far outweigh any minor undesirable effects discovered in this study.

MARY FRANCES POZ, M.D.

**Intravenous Procaine in Thoracic Surgery** N. M. BITTRICH and W. F. POWERS. *Current Res. Anesth.* 1948, 27, 181.

The authors report and summarize the use of continuous procaine infusion intravenously in combination with other agents such as cyclopropane ether and pentothal, during thoracic operations on 17 patients. The procaine infusion was employed in the particular attempt to control cardiac irregularities occurring in patients undergoing thoracic surgery.

Preoperative medication with nembutal morphine sulfate and scopolamine was used. The patients were anesthetized with cyclopropane nitrous oxide-oxygen-ether or pentothal nitrous oxide oxygen-ether and intubated with intratracheal tubes. Transfusion was begun and the patient was placed in the operative position. Assisted or controlled respiration was used as indicated. Before the pleural cavity was opened a continuous intravenous infusion of 1.0 per cent procaine hydrochloride in 5 per cent glucose solution was begun. Small amounts of pentothal were given intravenously from time to time to reduce the convulsant effects of the procaine.

In 5 of 17 cases arrhythmia occurred although the procaine solution was flowing at rates from 60 to 100 drops per minute. A rate of 150 drops per minute was required to correct arrhythmia in one patient. This has raised the question as to whether or not a single dose of from 50 to 100 mgm. can be expected to control cardiac arrhythmia especially if it is the result of more serious cardiac dysfunction than was present in these patients. Mild convulsions occurred during ether anesthesia in 4 patients whose disease was bronchiectasis and who had received insufficient amounts of pentothal. This appears to refute the suggestion that the susceptibility to the convulsant effects of procaine is diminished during general anesthesia. No harmful effects were seen in these cases.

The case reports emphasize the diminution of bronchospasm and coughing and the ease with which both could be controlled with the intravenous administration of procaine. The patients appeared to tolerate operations better and made easier recoveries. No patient who had been given procaine had any immediate sensation of pain upon awakening.

MARY KARP, M.D.



# PHYSICOCHEMICAL METHODS IN SURGERY

## ROENTGENOLOGY

**The Diagnosis of Suprasellar Tumors by Pneumoencephalography** N. S. SCHLESINGER and J. GEORGE TRIFLICK. *Am J Roentg* 94: 60-71.

The authors reviewed the pneumoencephalographic findings in 5 patients in whom a diagnosis of suprasellar neoplasm had been made in an attempt to determine whether a conclusive diagnosis of tumor in the suprasellar region could be made early by means of routine pneumoencephalography. This survey disclosed a striking alteration in the appearance of the cisterna chiasmatica, best described as obliteration, in 4 cases in which the existence of a meningioma in the suprasellar region had been verified by operation and in another case in which the presence of a hypophyseal duct tumor is highly probable.

A control study of 150 consecutive pneumoencephalograms in which no suprasellar lesion was suspected shows 94 per cent visualization of the cisterna chiasmatica; therefore the authors conclude that obliteration of the cisterna chiasmatica warrants the presumptive diagnosis of a suprasellar tumor if a lesion in this area is clinically suspected.

FRANK L. HOWETT, M.D.

**The Pathologic Gall Bladder** FRANK GREENWOOD and E. SAMUEL. *Bull J Radiol* 94: 438.

The authors present an analysis of their cholecystographic studies of 500 consecutive cases of pathologic gall bladder. Routinely they used a single dose of dye and administered additional dye only in those cases which showed poor original concentration. Of those gall bladders thought to be normal 99 per cent required the additional doses of dye. Fluoroscopic examination with compression and spot filming was employed routinely. The authors state that with this technique they are better able to avoid overlying gas shadows. Further they believe that this part of the examination is just as important as the comparable fluoroscopic and roentgenographic examination of the duodenal cap in the erect position. Films were always made in the erect position, since this view was the only one which revealed 18 per cent of the nonopaque gall stones. When overlying gas shadows were particularly disturbing the demonstration of nonopaque stones was aided by the use of tomography.

P. W. W. EYLER, M.D.

**Contribution to the Radiological Study of Simultaneous Skin and Bone Manifestations in the Legs** (Contribution à l'étude radiologique des modifications osseuses et cutanées concomitantes dans la région des jambes). RENE GILBERT and GEORGES VOLUTER. *Acta radiol* 94: 30-40.

Bony reactions accompanying soft tissue alterations in the legs have long been known to radiolo-

gists. Do they follow or precede the modifications of the soft tissues? Do they result from local or systemic reactions? After a short summary of the literature the authors elaborate their theory.

Periosteosis being a constant and important finding its macroscopic and microscopic pathology is outlined. The periosteum is a conjunctive membrane which cannot be detected with x-rays even if it has been raised from the adjacent bone by a mass of blood or pus. It will be seen only if mineralized or ossified.

The first stage of periosteal reaction in repair processes consists in the production of a reticulum of osteoid calcium-free trabeculation which is radiolucent.

In the second stage, which constitutes the first roentgenological evidence, there is mineralization of the periphery of this reticulum which leaves a clear space between it and the underlying bone. This occurs toward the twentieth day.

Finally the clear zone becomes ossified and continuous with the cortex of the bone and the roentgenogram shows it as a thickening of the cortex. This is true of acute cases.

In chronic processes, periosteosis will, in most instances, be produced intermittently and show a lamellar appearance on the films. Fundamental roentgenological signs are then discussed.

1. There are morphological and structural modifications of the bone such as osteoporosis, osteosclerosis, and periosteosis, alternately or simultaneously and intermingled. It is interesting to note that osteoporosis of the head and malleolus of the fibula is an early sign, although the lesions are usually closer to the tibia. This is due to the fact that the volume of the fibula is considerably less than that of the tibia. Periosteosis, on the other hand, is seen almost as early in either bone. The interpretation is, of course, more difficult in the aged in whom periosteosis already exists.

2. Other modifications such as calcifications of the interosseous membranes, tendons, muscles, phleboliths and even arteriosclerosis occur later in the soft tissues.

The basic condition is most likely venous stasis which gives rise to skin soft tissue, and osseous manifestations. In varicose ulcers the osseous condition does not precede the vascular alterations, but it is detected earlier. Furthermore discrete osseous reactions are usually seen in the other leg which is free of ulcer.

In primary skin conditions such as tuberculous or ulcus rodens the bony changes are localized and occur without proportion to the lesions. In osteomyelitis, the alterations are seen much earlier in the soft tissues than in the bones.

In periosteosis such as is seen in varicose conditions, the first stage only is active. The two last stages are

passive and subjected to the laws of tissue growth and hormonal regulation. In this respect the process is similar to that seen in some generalized infections such as syphilis and certain types of intoxications.

JEAN P. JEAN, M.D.

**A Decade of Experience with Plesiorontogenotherapy**  
*applied in Tumors of the Skin and Mucosa (Un decennio di esperienza nella plesiorontoterapia dei tumori della cute e delle mucose)* C. PORTA. *Tumori* Milano 1948 34 119.

Plesiorontogenotherapy (PRT) has been employed at the National Institute for the Cure of Tumors at Milan, Italy, in 605 cases during the period from 1935 to 1944. The apparatus used was the original type of Chaoul's (Sieman's tube). The factors for its function are 55 kv. and 4 ma. with a focal distance of 5 cm. and filtration equivalent to 0.2 mm. of copper. The field chosen for irradiation was never larger than 3 cm. in diameter. The usual dosage consisted of 6,000 roentgens in fractional doses of from 500 to 600 roentgens daily on consecutive days. In the cases of melanoblastoma the dosage was higher at times reaching 10,000 roentgens in a single course or even from 20,000 to 25,000 roentgens in two or more courses. For the recurrences which developed after some years the dosage and fractionation was the same as for the original course. In the more recent recurrences, however, the dosage was somewhat smaller (from 4,000 to 5,000 roentgens) with fractions of from 300 to 400 roentgens in some cases; nevertheless, in the majority of these patients the fractionation ranged from 500 to 600 roentgens.

The total rate of cure was 54 per cent, however only 416 of the patients were available for later control studies and the cures when based on this number amounted to 82 per cent. These figures however do not faithfully mirror the results of treatment since they included many patients with tumors notoriously resistant to irradiation therapy (melanoblastomas and tumors of the internal angle of the eye). Many of the latter patients, although cured locally later developed distant metastases of the lymph glands and these were unfairly perhaps included among the figures for failure of cures. Seven "before and after" photographic reproductions illustrate the excellent cosmetic results obtained and the absence of trophic sequelae in the irradiated skin areas.

The lesions treated included newgrowths of the buccal and nasal mucosa, the mucosa of the prepuce and clitoris, tumors of the skin and tumors of the ocular and especially corneal conjunctiva. Best adapted to this form of treatment seemed to be the neoplasms of the bridge of the nose, the internal angle of the eye and the lobe of the ear. In these cases the results were satisfactory as far as local cure and freedom from recurrence were concerned and there were fewer reactions and necrotic degenerative changes of the underlying cartilage than following treatment with radium or other forms of irradiation. Excluded were the highly malignant deeply infiltrating growths

which are suitable for radium therapy. Nevertheless, the method could be applied also in some of these cases particularly for tumors developing upward from the skin surface where the protruding masses or growth could previously be removed by diathermic excision. Tumors more than 3 cm. in diameter could also be treated by contact therapy when the area could be irradiated in several contiguous fields.

The author regards plesiorontogenotherapy (contact therapy) as the method of choice for tumors of the skin and mucosa always of course on the basis of its inherent limitations and provided that the method be applied with a rigidly correct technique.

JOHN W. BRENNAN, M.D.

**Colloidal Lead Orthophosphate Associated with Deep Roentgen Therapy in Bone Metastases from Cancer of the Breast** LAWRENCE REYNOLDS, T. LEUCUTIA, JAMES C. COOK and KENNETH E. CORRIAM. *Am. J. Roentg.* 1948 60, 193.

The authors treated 355 cases of bone metastases chiefly from carcinoma of the breast with preliminary intravenous injection of colloidal lead orthophosphate in conjunction with roentgen therapy. The present method consists of intravenously injecting an average dose of 30 c.c. of colloidal lead orthophosphate suspension containing 120 mgm. of lead. This in 3 days is followed by a series of deep roentgen treatments. As a rule the rays obtained with 200 kv. and 1 mm. of copper are used and full erythema doses are given per field at one session. The number of fields selected for crossfiring depends on the physical measurements of the part of the body to be irradiated. Occasionally in very heavy patients supravoltage roentgen therapy is employed because of greater depth dose. The entire series is completed in a period of from a few days to 2 weeks. Hospitalization of from 20 to 30 per cent of the cases is necessary because of severe treatment reactions. The injection of the colloidal lead is repeated 2 months later and followed again in 3 to 4 days by a second series of deep roentgen treatments. The reaction is usually less severe. Additional treatment series may be given if there is additional spread of the carcinoma. In one case a total of 1,200 mgm. of colloidal lead orthophosphate was injected over a period of 10 years with twelve series of deep roentgen treatments with gradually reduced doses. The only contraindications to the administration of the colloidal lead are severe liver damage, nephritis and very marked anemia. In about 20 per cent of the cases the intravenous injection of colloidal lead orthophosphate is followed within 1 to 2 hours by a chill and a temperature elevation reading up to 103 F.

The symptomatic improvement has been satisfactory in 95 per cent of the cases. The complaints in conjunction with the invasion of the osseous skeleton by the malignant neoplasms begin to abate in about 10 to 14 days. In 3 months there is very solid reossification of the formerly destroyed area.

of the bone which permits resumption of limited activities. The average survival amounted to 3 years. In 4 per cent the survival was more than 3 years. The patient who survived longest lived 30 years but there were no permanent cures.

The preliminary intravenous injection of colloidal lead orthophosphate in conjunction with roentgen therapy leads to a three-fold effect in the malignant neoplastic invasion of the osseous system: the lead has a certain toxic action in itself; there is a direct destructive effect of the roentgen rays and the heavy lead atoms deposited within the tumor area emit, under the influence of roentgen irradiation, ionizing secondary electrons which also act on the carcinoma cells. More recently attempts were made to use radioactive lead orthophosphate to aid internal irradiation. However, further investigations especially with "tagged" lead are necessary before worthwhile therapeutic efforts can be undertaken.

FRANK L. HUMERY, M.D.

**The Use of Adrenal Cortical Hormone in Radiation Sickness.** FREDERICK LILLY, JR. *Radiology* 94:8, 5 394.

The symptomatology of radiation sickness points to adrenocortical insufficiency. Irradiation of a sufficiently large volume of the body results in the release of histaminelike substances if not of histamine itself. These substances cause the anterior pituitary to secrete a corticotrophic hormone which in turn stimulates adrenocortical activity. This stimulation may well result in exhaustion of the gland.

In a recent study with mice as the test objects, the author used desoxycorticosterone acetate (DCA), a synthetic hormone of the adrenal cortex, in the treatment of radiation sickness. It was demonstrated that DCA protects the liver against radiation-induced fatty changes and that this liver-protecting action is accompanied by a decrease in the mortality rates produced by various doses of x-rays applied in total body irradiation. It was demonstrated, furthermore, that both effects are dependent on the size of the daily dose of DCA. 0.5 mgm. was found to be an optimal dose for daily administration. The lethal effect of L.D. 50 was reduced by almost 50 per cent.

The author's studies were extended to include the influence of DCA on the effects of x-rays on the spleen, bone marrow and adrenal cortex. One hundred male Swiss white mice were given total body irradiation and then killed at different intervals. The results of the study of the spleen, bone marrow and adrenal cortex in animals which were irradiated, and in those which were irradiated and treated daily with 0.5 mgm. DCA were compared. The author observed no change in the x-ray induced

effects on the spleen. On the bone marrow, however, a definite and statistically relevant change was noticeable in the DCA-treated group. Similarly, a decreased depletion of sudanophilic fat of the adrenal cortex was observed in the animals receiving DCA.

In a series of 50 patients who exhibited nausea or vomiting or both, 37 were completely relieved of these distressing symptoms. It is believed that DCA may prove of value not only in the treatment of radiation sickness encountered as a complication of radiation therapy but also in radiation sickness occurring as a result of accidental exposure to lethal doses of ionizing radiations.

FRANK L. HUMERY, M.D.

### MISCELLANEOUS

**Radioactivity and Urinary Tract Calculi.** DAVID S. C. ISHOL, ALBERT E. BOTHER, and PAUL W. GROSZNER. *N. England J. M.* 1948, 35:437.

The authors report a very interesting case of radioactivity of a bladder stone.

The patient, a male 56 years of age, who had a vesical calculus as well as multiple prostatic calculi, was also afflicted with polycythemia vera. Preparatory to the operation for the calculi, orally radioactive phosphorus for the polycythemia was administered. He received a first dose of 6 millicuries, and 3 months later a second dose of 10 millicuries. During all this time the increase in size of the bladder calculus was observed by means of repeated roentgen studies and cystoscopic examinations. Sixty-one days after the second oral dose of radioactive phosphorus a suprapubic cystostomy was performed and the vesical calculus together with some of the prostatic calculi were removed.

The stones then were analyzed for radioactivity. Both the Geiger counter and the autoradiographs showed that the vesical calculus was markedly radioactive. There was a laminated layer at the periphery which represented deposited radioactive phosphorus from the urine. This layer corresponded to the increase in size of the stone during the period of administration of the drug. The prostatic calculi, which were not in contact with the urine and also were presumably not enlarging during the period of phosphorus therapy, were not radioactive.

It is the authors' opinion that the method might serve as a control of the efficacy of various proposed procedures for the prevention of additional stone formation, as, for example, the effect of an acid ash diet on the formation of alkaline stone. It also offers an opportunity for the study of the action of radioactive materials on associated infections of the urinary tract. The possible effect of the radioactive stone on the surrounding tissues must also be considered.

T. LECOTTE, M.D.

## MISCELLANEOUS

### CLINICAL ENTITIES—GENERAL PHYSIOLOGICAL CONDITIONS

Some Supplementary Leads in Clinical Electrocardiography. KARL ERIK GREWIN. *Acta med scand.*, 1948 130 Supp 309

Considerable interest has been evidenced in electrocardiographic circles with regard to special leads. The author presents an adequate historical résumé of the subject, and reviews the contributions of many authors in Europe and the United States.

His critical evaluation of the many reports contained in the bibliography of the text are objective and interesting. The author also presents a report of his own experience in the field.

CHAUNCEY C. MAHER, M.D.

The Effects of Altered Arterial Tensions of Carbon Dioxide and Oxygen on Cerebral Blood Flow and Cerebral Oxygen Consumption of Normal Young Men. ERMOUR S. LUTY and CARL F. SCHMIDT. *J Clin Invest.*, 1948, 28 484.

The effects of the inhalation of 5 to 7 per cent  $\text{CO}_2$ , 85 to 100 per cent  $\text{O}_2$ , and 10 per cent  $\text{O}_2$  were studied on the composition of arterial and internal jugular blood on blood flow, oxygen consumption and vascular resistance of the brain and on cardiac output and blood pressure.

$\text{CO}_2$  inhaled in concentrations of 5 to 7 per cent produces an increase in cerebral blood flow averaging 75 per cent.  $\text{O}_2$  inhaled in concentrations of 85 to 100 per cent is associated with a reduction in cerebral blood flow of 13 per cent while 10 per cent  $\text{O}_2$  produced an increase of 35 per cent in this function.

These changes are statistically significant. Calculation of cerebrovascular resistance indicates that in every case the change in blood flow is due to a change in the vascular resistance of the brain. Cerebral oxygen consumption is not significantly altered by changes in the composition of inspired air over the ranges studied. Mean arterial blood pressure rose significantly during the  $\text{CO}_2$  and high  $\text{O}_2$  inhalations and fell slightly with 10 per cent  $\text{O}_2$ . The only significant change in cardiac minute volume was an increase which occurred during 10 per cent  $\text{O}_2$  inhalation and resulted from an increase in rate rather than stroke volume.

WALTER H. NADLER, M.D.

The Effects of Various Amino Acids on Peripheral Blood Flow and Skin Temperature. MARTIN B. MACHET. *J Clin Invest.*, 1948 28 454.

Skin and rectal temperatures, total oxygen consumption and blood flow through the hand were studied in 4 healthy young males before and after the oral administration of seven amino acids.

At an environmental temperature of 24 centigrade glycine produced a significant rise in the skin temperature of the hands and in the dosage used

resulted in a significant increase in blood flow through the hand. These increases generally became apparent about 30 minutes after the glycine ingestion and were most marked after about 180 minutes. Save for similar but less marked increases in toe temperature, no significant temperature changes were noted elsewhere in the body, including the rectum. At 15° centigrade and 30° centigrade, no significant changes in rectal or skin temperature or peripheral blood flow followed the administration of glycine. At an environmental temperature of 24 centigrade, changes similar to those produced by glycine were observed after the administration of di-phenylalanine, only a very slight and questionably significant increase in hand skin temperature and blood flow through the hand were noted after 1 (+) histidine monohydrochloride, no effect was produced upon rectal or skin temperature or on the peripheral blood flow after ingestion of 1 (+) glutamic acid 1 (—) tyrosine 1 (—) leucine and di-methionine.

Although five of the seven amino acids used caused a definite increase in oxygen consumption, there were no consistent quantitative relationships between total oxygen consumption and skin temperature or peripheral blood flow.

WALTER H. NADLER, M.D.

The Effects of the Rate of Administration of Amino Acid Preparations on Urinary Wastage of Amino Acid Nitrogen in Man. CHARLEY J. SMYTHE, STANLEY LUTY and ANDREW G. LAMICHAK. *J Clin Invest.*, 1948 28 418.

In 15 human subjects a comparison was made of the urinary loss of amino acid nitrogen in a 4 hour period after the administration of three different amino acid preparations, each containing 5.4 gm. of nitrogen. In 5 of these subjects the amino nitrogen content of the urine was determined for the same period after an infusion of physiological salt solution. The protein hydrolysate injection rates used were those shown by previous experience to approach the maximum tolerated rate of the majority of the patients. The greatest urinary amino acid nitrogen wastage occurred with the solutions prepared by the enzymatic hydrolysis of casein, which preparation contained large amounts of peptide nitrogen. The increased loss of total amino acid nitrogen seemed to be due mainly to bound amino acid nitrogen. In a 4 hour period the per cent of the total administered amino acid nitrogen lost in the urine ranged between 16 and 19.7 per cent. After the administration of either an acid hydrolysate of casein or a mixture of amino acids under similar conditions, usually only 3 to 5 per cent of the total amino acid nitrogen was found in the urine. In contrast, there was little free amino acid nitrogen lost after the administration of any of the preparations studied regardless of the speed of infusion. Mixtures of amino acids if well

of the bone which permits resumption of limited activities. The average survival amounted to 3 years. In 4 per cent the survival was more than 5 years. The patient who survived longest lived 10 years, but there were no permanent cures.

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In 15 human subjects, a comparison was made of the urinary loss of amino acid nitrogen in a 4 hour period after the administration of three different amino acid preparations, each containing 5.4 gm. of nitrogen. In 5 of these subjects, the amino nitrogen content of the urine was determined for the same period after an infusion of physiological salt solution. The protein hydrolysate injection rates used were those shown by previous experience to approach the maximum tolerated rate of the majority of the patients. The greatest urinary amino acid nitrogen wastage occurred with the solutions prepared by the enzymatic hydrolysis of casein, which preparation contained large amounts of peptide nitrogen. The increased loss of total amino acid nitrogen seemed to be due mainly to 'bound' amino acid nitrogen. In a 4 hour period, the per cent of the total administered amino acid nitrogen lost in the urine ranged between 1.6 and 19.7 per cent. After the administration of either an acid hydrolysate of casein or a mixture of amino acids under similar conditions, usually only 3 to 5 per cent of the total amino acid nitrogen was found in the urine. In contrast, there was little free amino acid nitrogen lost after the administration of any of the preparations studied, regardless of the speed of infusion. Mixtures of amino acids, if well

tolerated can be given at exceedingly rapid rates without causing increased spillage into the urine.

WALTER H. NADL, M.D.

**Is Tuberculosis Present or Not? Histologic Examination or Inoculation? (1. Is tuberculosis or non? Examen histologique ou inoculation?) Erickson. *Urolog. Medet chir. acta* 943, 5, 5.**

After the inoculation of guinea pigs with the fluid obtained from 40 patients with pleurisy the author obtained positive results in only 12 instances or 30 per cent. The clinical examination left no doubt concerning the tuberculous origin of the condition. Of 30 patients with tuberculous adenitis only 6 gave positive results on inoculation of guinea pigs.

The glands removed from the aforementioned group of 30 patients were studied histologically. Of 50 sections 43 showed signs of tuberculosis. Only in 7 cases the results were negative with regard to tuberculosis. In one of them the inoculation had given a positive result in an initial stage of the tuberculosis, while in the other case the calcification was so complete that no more signs of a specific lesion could be detected. All the glands were removed from the abdominal cavity. Similar results were obtained with tuberculous cervical ganglia. In only 1 of 5 cases was the result of the inoculation positive, while histologic study established the diagnosis of tuberculosis in the 4 others. The process was in full stage of evolution in all instances.

The third series of tests dealt with tuberculous material of various origins, collected in the course of operations. In only 6 of 10 tests was the inoculation positive, while histologic examination demonstrated the presence of tuberculosis in every instance.

If a surgeon is confronted with the question "Is tuberculosis present or not?" undoubtedly the histologic examination will furnish the most reliable reply. In 90 per cent of the cases a negative inoculation does not determine whether active microbial activity is present or not. An investigation should be made to ascertain whether as small a number of bacilli as is generally assumed is sufficient to infect a guinea pig with tuberculosis.

JOSEPH K. N. RA, M.D.

**Effect of Oral Caronamide on Plasma Penicillin Levels Following Large Intramuscular Doses of Penicillin. ALBERT O. SKELER, HARVEY SKELER COLLINS, and MAXWELL FINLAND. *Am J M S* 943, 6, 24.**

Because of the rapid renal clearance of penicillin merous agents have been examined for their ability to block the tubular excretion of this antibiotic and thereby enhance the plasma levels obtainable from any given dose. While diodrast and para-aminohippuric acid are effective in this regard, their usefulness is restricted because of the need of large amounts by vein. Reports concerning the value of benzoic acid or sodium benzoate have been at variance.

The present study was undertaken to determine if caronamide given by mouth significantly en-

hances penicillin blood levels in man by reversibly inhibiting its excretion following the administration of single doses of 1 million units. Seven patients over 60 years of age, and 10 patients under 60 years were studied. Only those without any evidence of cardiac and renal disease were selected. Caronamide was given by mouth in tablet form: the older people receiving 3 gm. and the younger 4 gm. every 4 hours after administration of the penicillin. Plasma penicillin levels were determined at suitable intervals before, during, and after caronamide therapy. Two patients under 60, and 2 patients over 60 years of age, in whom caronamide was significantly effective, were later studied with sodium benzoate beginning with 3 gm. and repeating with 4.5 gm. after a few days.

In 6 of the 7 patients over 60 years, caronamide therapy enhanced the penicillin levels strikingly. Six hours after the penicillin was administered the levels with caronamide were about 10 times as high as those without caronamide and after 24 hours the penicillin level with caronamide averaged about 16 units, whereas at this time no penicillin could be detected in the control plasma. While the degree of enhancement varied widely in patients under 60, the plasma penicillin levels without exception were definitely higher during caronamide therapy than in the control period. After 4 hours the average difference was about 15 fold. Without caronamide little or no penicillin remained in the plasma 8 and 12 hours after the injection, while with caronamide 5 of the 10 patients evidenced penicillin levels as late as 18 hours.

Sodium benzoate had little if any effect on the penicillin level when given in doses of 3 gm. every 3 hours. When larger doses were administered the level was somewhat enhanced in 1 patient but not in the other 3. The only untoward sequelae to caronamide therapy were nausea in 4 patients with vomiting in 2 of them. While it is probable that penicillin levels could be further enhanced by increasing the sodium benzoate dosage, 3 patients complained of nausea with the dosage used.

Thus the oral administration of caronamide, together with large intramuscular doses of penicillin, makes it possible to maintain high penicillin levels with relative ease. The effect of caronamide in prolonging penicillin plasma levels is greater than that resulting from a 10 fold increase in the penicillin dosage.

D. VID H. LIND, M.D.

**Plasma Penicillin Levels After Oral Penicillin with and without Oral Caronamide. HARVEY SKELER COLLINS, ALBERT O. SKELER, and MAXWELL FINLAND. *Am J M S* 943, 6, 248.**

Studies on the effect of caronamide on the blood levels obtained during oral penicillin administration are the subject of this report. Male patients, both young and old in whom no definite evidence of renal damage, congestive failure or other serious illness was present were selected. On tablet containing 100,000 units of crystalline potassium penicillin G

buffered with 0.5 gm sodium citrate was given perorally every 4 hours beginning at 9 a.m. on day 1 and continued through 5 p.m. of day 4. Blood samples were drawn before dining and after the caronamide administration at such intervals as to provide several observations of the 4 hour level.

Caronamide tablets were also given orally the first dose at 1 p.m. of day 2 with doses repeated every 4 hours at the same time as the penicillin the final dose being given at 1 p.m. of day 3. Plasma penicillin levels between penicillin doses were obtained before the first and last doses of caronamide and again 10 hours after the last dose of caronamide. The caronamide was employed in 3 different dosages. 8 patients under the age of 60 received 4 gm. every 4 hours. 9 patients over 60 were given 2 gm. every 4 hours and 7 patients over 60 received 3 gm. every 4 hours. In the latter group blood caronamide concentrations were determined.

Oral penicillin when administered alone in doses of 100,000 units every 4 hours could not be relied upon to maintain significant concentrations of the antibiotic in the plasma in persons under the age of 60. Penicillin levels of 0.03 units per ml. were maintained in more than two-thirds of persons over 60 years of age on the same dosage. Presumably this is due to a reduction in the functional tubular excretory mass in older people. This also accounts for the greater enhancing effect of caronamide in the aged.

Caronamide in oral doses of 4 gm. every 4 hours in persons under 60 and in doses of 3 gm. every 4 hours in those over 60 enhanced and prolonged the levels from oral penicillin. This effect however seemed to be less marked than that observed in patients who had been given penicillin intramuscularly. In the group in whom only 2 gm. of caronamide had been administered every 4 hours the results were quite irregular and enhancement of penicillin levels throughout most of the caronamide period was noted in only 2 patients.

Determinations of plasma caronamide concentration indicate that absorption and/or excretion of orally administered caronamide varies in different individuals. This may account for the differences in the enhancing and prolonging effect of the caronamide and for the duration of its effects.

In patients older than 60 years with slightly elevated blood nonprotein nitrogen levels the enhancing effect of caronamide persisted for at least 28 hours after the caronamide was discontinued. This effect was associated with persistence of significant caronamide concentrations in the blood of these patients.

DAVID H. LYNN, M.D.

**Discussion of Multiple Tumors (Considerazioni sui tumori multipli)** L. BARBERA. *Tumori Milano* 1943, 34: 47

The presence of two different benign tumors in the same individual or the occurrence of one benign and one malignant tumor is relatively frequent, contrary to a concurrent or successive development of two different malignant neoplasms. Three such cases are reported by the author.

A 57 year old woman had had her left breast removed at the age of 45. The diagnosis was adenocarcinoma. Twelve years later she developed an ovoid tumefaction of hard elastic consistency in the epigastric region. The roentgenologic examination disclosed the presence of an infiltrating and vegetating tumor on the lesser curvature of the stomach.

A 75 year old woman had been operated on at the age of 50 years for adenocarcinoma of the left breast. Five months prior to her admission to the hospital she developed meteorism and pain in the right lower quadrant of the abdomen. The autopsy revealed an adenocarcinoma of the right ovary with metastases in the spleen, omentum and liver.

The third patient a woman 64 years of age had undergone an amputation of her right breast at the age of 52 years for a medullary carcinoma. Ten years later an adenocarcinoma of the left breast necessitated the removal of that organ.

In all 3 cases the family history disclosed the occurrence of malignant neoplasms in one or more members of the family. In the first case 12 years had elapsed between the first and the second tumors. In the second case the period was 25 years and in the third case 10 years. In all 3 instances the first tumor was located in the breast. All 3 women had had normal menstrual function and all were multiparas.

JOSEPH K. NARAT, M.D.

**Benign Giant-Cell Synovioroma and Its Relation to Xanthoma** M. J. STEWART. *J. Bone Surg.* 1948, 30-B: 522

The majority of benign synovioromas occur in the flexor tendons of the fingers and thumb although some are of articular bursal or tenosynovial origin. Nearly three-quarters of the 40 cases of benign synovioromas observed in the routine surgical material from 1914 to 1947 at the General Infirmary at Leeds, were from the fingers in contrast to the occurrence of malignant synovioromas which usually arise from the joints or bursae of the lower limbs (with less than 4 per cent from the fingers). The sex ratio for benign synovioromas is 1.3 male to 1 female. These tumors are rarely found in persons under 10 years of age or over 60 years of age.

Benign tumors of synovial origin are more properly called benign giant-cell synovioromas. Since there is no xanthoma cell the term xanthoma is a misnomer. Cells of varied histogenesis including histiocytes, fibrocytes, serosal endothelial and synovial cells as well as neoplastic cells from the synovium (i.e. differentiated histiocytes) phagocytize lipid and cholesterol esters derived from extravasated blood disintegrating tissue or secreting products to form the large lipid laden cells found in these tumors.

FRANK B. QUEEN, M.D.

**Clinical and Histological Considerations of Liposarcoma (Considerazioni cliniche ed istogenetiche sul liposarcoma)** ATTILIO BASILE. *Arch. Ital. Chir.* 1943, 70: 183.

A rare case of liposarcoma with its various phases of malignant evolution is presented.



The 60 year old patient first noted a small tumor mass on the lower right chest wall, about as big as a nut 6 years previously. This gradually increased in size until it reached the size of a fetal head but did not cause any symptoms. Three months before he was seen however the increase in size became more rapid and the tumor also became quite painful. When seen it had attained the size of a large melon. Clinical investigation, including roentgenograms of the chest and aspiration biopsy were negative. A clinical diagnosis of liposarcoma was made and the mass excised under sodium pentothal anesthesia. The superficial part of the mass was divided into two parts by a deep sulcus but these parts were covered by the same capsule. On the under surface was found another mass as large as an orange penetrating into the deeper structure and adherent to the peritoneum of the rib for an area of 3 by 4 cm and also to the adjacent structures. It was also firmly adherent to the superficial mass.

The superficial portion was found to be a lipoma however the deeper portion was found to possess an incomplete capsule. It was of a reddish gray color and rubbery in consistency. The microscopic picture was that of a liposarcoma.

From the study of this case and a review of the literature the author believes that the following considerations are correct.

Liposarcomas are rather rare and they may be encountered in any part of the body wherever there is adipose tissue. They are most frequently found subcutaneously or retroperitoneally.

Their morphology varies a great deal and hence the histologic interpretation and classification are difficult.

After evaluation of the microscopic reports and clinical course many of the fibrolipomas, pseudolipomas, fibromyxolipomas, and atypical lipomas reported in the literature will be considered true liposarcomas.

LEON J. FAYETTE, M.D.

## DUCTLESS GLANDS

*Studies on the Stilben Estrogens. Action on the Prostat (Ricerche sugli estrogeni stilbenici. Azione sulla prostata) P. LA VOTTA and V. MORTINO. Tumori Milano, 943 36 71*

Eight dogs were used in the authors' experiments because the prostate glands of the animals are the best developed of all animals used for experiments and are most responsive to the estrogen. Six of these dogs were treated for a month with daily intramuscular injections of 2 mgm. of diethyl dihydrostilbene per kilogram of body weight. Four of these were castrated one week before initiation of the injections. The 2 remaining animals were similarly treated but the injections were terminated after 15 days. These animals weighed from 4,500 to 5,500 gm. and were from 6 to 12 months of age. The dosages employed were considered equivalent to those employed in the human being in the treatment of cancer of the prostate gland.

Histologic examination of the prostate glands of these treated animals disclosed in every instance a proliferation of the prostatic stroma and a metaplasia of the epithelium of the prostatic urethra and of the periaurethral glands. The glandular epithelium of the prostate, on the other hand, exhibited regressive changes. Here the normally present cubical or cylindrical polystratified epithelium of the mucosal type was replaced by a monostratified flat epithelium apparently inactive as regards secretive function. There was no notable difference between the mode of response of the castrated animals from that of the noncastrated ones.

From their studies on this material the authors feel justified in postulating a direct action of the estrogenic preparation of an elective character on the prostatic tissues which suggests that this preparation is in the nature of a sexual hormone.

JOHN W. BRENNAN, M.D.









Fig. 8



Fig. 20



Fig. 9



Fig. 1

*A 1 mm and 1 Re Eten we len of Camper's Scarpa's and Colles Fasciae*  
*Charles E. Tobin and John A. Benjamin.*

*(Legends on opposite page.)*

# SURGERY

## GYNECOLOGY AND OBSTETRICS



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### ANATOMIC AND CLINICAL RE-EVALUATION OF CAMPER'S, SCARPA'S, AND COLLES' FASCIAE

CHARLES E. TOBIN Ph.D., and JOHN A. BENJAMIN M.D., Rochester New York

THE subcutaneous tissue of the ventral abdominal wall particularly that distal to the umbilicus is described in the anatomic and clinical texts as consisting of a superficial fatty layer (Camper's fascia) and a deeper membranous layer (Scarpa's fascia). These two layers supposedly fuse and continue caudally as the dartos layer around the penis and scrotum wherein

the continuity of Camper's fascia is not fatty and involuntary muscle fibers are imbedded in these fused layers. In the perineum the continuations of the two layers are described as having the same pattern as that found over the ventral abdominal wall—a superficial fatty layer in the urogenital triangle, continuous with the fat in the ischioanal fossa and a deeper membranous layer (Colles' fascia) which is adherent to the inferior rami of the pubis and ischium and to the posterior border of the urogenital diaphragm. The continuity of the membranous layer into the ischioanal fossa is not well established.

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This study was supported in part by funds from the Dr. Henry C. Burwell Memorial and the Field Research Fund of the University of Rochester School of Medicine and Dentistry.

Fig. 18. Kodachrome of a sagittal section through the pelvis from a male cadaver with simulated urinary extravasation from the penile urethra. The red liquid latex injected into the perforated penile urethra has infiltrated all of the subcutaneous tissue between the dermis and the layers of Buck's fascia over the components of the penis in the perineum, the tunica vaginalis in the scrotum. Buck's fascia along the shaft of the penis, the intrinsic fascia over the aponeurosis of the external oblique muscle, and into the superficial part of the ischioanal fossa. Note that the simulated extravasate is not limited by an inner membranous layer (Scarpa's-Colles' fasciae) but infiltrates the entire thickness of the subcutaneous tissue. X-17.

Fig. 19. Kodachrome of a partial dissection of the subcutaneous tissue of the lower abdominal wall, the penis, and scrotum from a male cadaver with simulated urinary extravasation from the penile urethra. The skin has been removed from the areas shown. Note the red latex, within the entire thickness of the subcutaneous tissue in the scrotum and immediately above the pubic symphysis. A larger quantity of simulated extravasate would have filled the entire thickness of the subcutaneous more cephalad over the ventral abdominal wall. X-15.

Fig. 20. Kodachrome of a dissection from a simulated case of extravasation. The skin has been removed and the layers of spermatic fasciae have been opened and retracted.

The simulated extravasate infiltrated the layers of spermatic fasciae superficial to the tunica vaginalis testis and ascended retrogradely upward into spermatic cord. X-3.

Fig. 21. Kodachrome of a dissection from a simulated case of extravasation from the penile urethra. The skin has been removed from the penis and scrotum. The subcutaneous tissue has been incised in the midline and reflected laterally over the lower abdominal wall and along the dorsal shaft of the penis. The aponeurosis of the external oblique muscle is opened over the rectus abdominis muscle and down through the right inguinal canal (left side of illustration). The other layers of the rectus sheath have also been opened transversely and longitudinally near the umbilicus. Note that the yellow latex used to simulate the extravasate infiltrated the spermatic cord from the lower part of the scrotum and ascended retrogradely through the inguinal canal. Also note the simulated extravasate in the subcutaneous tissue along the shaft of the penis. Some of the latex also followed along the areolar tissue surrounding the superficial vessels and nerves and entered into the layers of abdominal muscles at the points where the vessels and nerves made their exits, as shown by the latex over the rectus sheath and on the aponeurosis of the external oblique muscle. The sac of an indirect inguinal hernia is shown at the left subcutaneous inguinal ring (right side of figure). X-2.

The importance of the connections of the membranous layer to the deep fascia and periosteum of the body wall, and its continuity from the perineum around the scrotum and penis and over the ventral abdominal wall has been stressed in both anatomic and clinical texts because of its role (1) in limiting and directing the course of extravasated urine blood pus or gases (2) as a surgical guide in making drainage incisions and (3) in the approximation of the edges of the membranous layer in surgical closure of incisions in the ventral abdominal wall and in the perineum. The presence of an outer subcutaneous fatty layer in many parts of the body is accepted but there is some doubt as to the presence and the continuity of a definite deeper membranous layer (Scarpa's and Colles' fasciae) which is distinct from the outer fatty layer in the regions under consideration.

In the first place there appears to be no established definition of or priority for the terms Camper's and Scarpa's fasciae. The original papers by Camper (1768 and 1801)<sup>1</sup> and Scarpa (1809)<sup>2</sup> which might possibly have been the source of these terms dealt primarily with the anatomy and surgery of hernia and did not describe these layers as they are currently defined in the *anatomic and clinical* texts but through some sources as yet unidentified and by repetition of erroneous text descriptions and illustrations their names have become associated with these layers.

In 1811 Colles described a dense fascial layer in the perineum but he did not state whether it was fatty or membranous in character nor whether it was attached to the posterior border of the urogenital diaphragm as shown in the following quotation from his work:

"Now proceed to dissect the perineum. Raise the skin of the perineum extending the dissection beyond the tubera ischia to the thighs. This exposes to

A study of the available works by Petrus Camper on many phases of his medical research, as well as the *Oeuvres de Pierre Camper* (Paris, H. J. Jansen, 1803, 7-11) and the commemorative paper on the 50th anniversary of his death (*Nederl. Tijds. Geneesk.*, 190, 25, 1893-1917) contain no mention of his association with the superficial fatty layer of subcutaneous tissue. The Dutch endogists most likely would have given him credit for naming this fascia if he had done so.

For John Struthers (1854) was the earliest source found to use the term Scarpa's fascia and then only for brevity of description rather than from authoritative definition (See: Tobias and Benjamin, 1944 for quotations from this paper).

view a strong fascia, which, on dissection will be found to cover the entire of the perineum and to blend itself with the structure of the scrotum. This fascia, although on a superficial view it appears continuous with the fascia of the muscles of the thigh will yet be found on closer examination to attach itself very firmly to the rami of the ischium and pubis. The texture and connexions of this fascia will serve to explain many of those phenomena attendant on the effusion of urine into the perineum by rupture or ulceration of the posterior part of the canal of the urethra. First, then you will find that this fluid when so effused, although it forms a tumour in perineum, rarely terminates by suppuration and ulceration in this spot being here resisted by the dense and unyielding texture of the fascia, diffusion laterally towards the thighs is prevented by the close attachment of this fascia to the rami of the pubis and ischium while its progress forwards is favoured by a quantity of cellular substance, interposed between the surface of the perineal muscles and this fascia.

Before you raise this superficial fascia of the perineum, it may be of use to make a transverse incision through it, midway between the tuberosities of the ischia and the arch of the pubis. This incision will enable you to see the muscles of the perineum, lying in their natural situations. Proceeding in the dissection, now remove the superficial fascia of the perineum, and then clear away some cellular substance covering the muscles so as to give a distinct view of them. Next remove these muscles taking care not to cut another fascia which lies under them and which we shall presently examine under the name of the anterior layer of the triangular ligament of the urethra or membranous septum of the perineum.

Therefore except in the case of Colles' fascia original definitions are not given for the extent and connections of these fascial layers, and the fatty or membranous nature of all three fasciae is not established. It is interesting to note that Scarpa's and Colles' fasciae are not mentioned in Gray's *Anatomy* until 1897 while Camper's fascia was not defined until the 1901 edition.

Secondly the indefiniteness as to the existence of the inner membranous layer is further evident from the accounts and illustrations given in the current texts and journals regarding the structure, position and connections of this layer from an anatomic and clinical point of view.

Histologically the subcutaneous tissue, except in certain limited regions of the body devoid of fat like the eyelids or external ear consists of a network of collagenous and elastic fibers surrounding lobules of fat, which extend from the periosteum or deep fascia to

the dermis. It is also now generally agreed that fat is formed within the fibroblast like cells (Clark and Clark, 1940) of the collagenous-elastic network in the subcutaneous tissue and that the proportion of fat to fibers varies with the obesity of the individual and with the area of the body under consideration. Therefore, except in certain regions where the subcutaneous tissue is devoid of fat, a definite membranous layer is not found. Besides, fat cells do not exist individually or in groups without an embedding connective tissue framework (Bremer and Weatherford 1944).

The current descriptions of these fascial layers found in the texts also do not agree with specific studies of the subcutaneous tissue. For example Blechschmidt (1930) in making a study of the subcutaneous tissue from many regions of the body in infants and adults based upon frozen sections stained with methyl blue or van Gieson stains and photographed by transillumination or reconstructed as waxed models observed no subdivision of the subcutaneous tissue into an outer fatty and an inner membranous layer. Only one layer consisting of fat embedded between strands of connective tissue was found between the body wall and the dermis in many areas of the body. Congdon and associates (1946) employing relatively thin sections of the ventral abdominal wall several inches in length cut with a razor blade and stained with a fat stain (Sudan IV) also demonstrated only one layer composed of sheets of connective tissue around deposits of fat in the subcutaneous layer. Any one of the collagenous-elastic sheets within the fat could be called the membranous layer. A similar finding was reported by Forster (1937) studying the cut edges of incisions made into or through the subcutaneous layer of the ventral abdominal wall of cadavers. The fibrous strands or sheets which might be called the membranous layers were embedded within the subcutaneous fatty panniculus with fat on both sides of the membranous sheets or strands. Other specific works dealing with the fascia of the human body such as the one by Singer (1935) also show that membranous layers are embedded within the fat. Some texts even consider the inner membranous layer as the under or deepest surface of the tela subcutanea,

as opposed to the preceding view (Davis 1918 McGregor, 1946). Further confusion is added since it is also stated that the superficial lymph nodes or vessels vascular channels, and cutaneous nerves run between Camper's and Scarpa's fascia, whereas other texts indicate that they course within Camper's layer. In the perineum the posterior scrotal nerves and vessels are described as running deep to superficial to or within Colles' layer.

Although it is generally stated that extravasates in the perineum do not diffuse further dorsally than the limits of the superficial transverse perineal muscles (posterior part of the urogenital triangle) cases are recorded where extravasates were found along the sides of the anus in the ischiorectal fossa (Wolfer 1918). The membranous layer is described as fused with the inguinal ligament or immediately distal to this ligament, with the fascia lata of the thigh. However, extravasates (particularly blood) have been known to pass down on the front of the thigh distal to these connections. The presence of one subcutaneous layer—fatty and membranous components intermingled and not two separate and distinct layers—would help to account for these anatomical and clinical differences.

Except for the microscopic studies mentioned above methods of definitely establishing the presence of these layers have been questionable. Grossly it is not possible in the majority of instances to demonstrate a definite inner membranous layer over the ventral abdominal wall or in the perineum of the normal cadaver or patient without creating such a layer artificially by dexterous use of the scalpel as many anatomists and clinicians are well aware. The collagenous-elastic components of the subcutaneous tissue may be thickened due to the resultant inflammatory process when large amounts of extravasated urine, blood, pus or gases are present in this tissue or these components may also be thickened by stress due to subjacent herniation or abnormal growths. In such instances a definite inflammatory or tensile membranous layer will easily be found—but usually with fat on each side of the layer.

A restudy of the subcutaneous tissue over the ventral abdominal wall, penis, scrotum,



and perineum was made in order to re-evaluate the anatomy and the clinical importance of Camper's, Scarpa's and Colles fasciae in view of (1) the indefiniteness of the structure of the subcutaneous tissue (2) the presence of a membranous layer (or layers) within or at the deep surface of this tissue and (3) the connections of the membranous layer to the deep fascia or periosteum which would limit and direct the spread of extravasates and infections.

#### MATERIAL AND METHODS

The following methods of approach were utilized to study the subcutaneous tissue of these regions.

1. Microscopic sections were made after fixation in 10 per cent formalin or Zenker acetic solution (a) from blocks of the hypogastric region of the ventral abdominal wall, including all the tissue from the peritoneum through the epidermis from 6 adult male cadavers of varying obesity for the normal adult structure of the subcutaneous tissue (b) from samples of the tissue called Scarpa's fascia," obtained from the abdominal wall of 5 patients at operation for the surgical concept of this layer and (c) from segments of the abdominal wall taken from 3 cases of urinary extravasation (from the penile urethra) to determine the tissue involved in this type of extravasation. In most instances, these tissues were

cut at 10 micra in paraffin and were stained with Heidenhain's modification of the Mallory connective tissue stain. Other samples of the same tissues were also cut in celloidin or with the freezing microtome and stained with hematoxylin and eosin orcein (for elastic fibers) or the Heidenhain's connective tissue stain in addition Sudan IV or Sudan black B were used as fat stains on selected sections.

2. Macroscopic sections were also made since the amount of tissue which can be cut in paraffin and celloidin or with the freezing microtome is so limited and hence the continuity and attachments of the connective tissue layers is interrupted by these methods. These macroscopic sections were made by embalming the larger specimens with, or immersing the smaller ones into 10 per cent formalin and subsequently freezing them with dry ice (solid CO<sub>2</sub>). Such specimens consisted of (a) a portion of the body including the lower abdomen, pelvis and thigh from 5 full term male fetuses which were cut on a Vaughan high speed band saw (3 cut in the sagittal and 2 in the coronal plane) as 1/4 inch thick sections (b) comparable regions from 5 adult males similarly prepared and cut (3 in the sagittal and 2 in the coronal plane) as 1/4 inch thick sections (c) segments of the ventral abdominal wall approximately 3 to 5 inches long and 1 to 2 inches wide taken parallel to the mid rectus incision distal to the umbilicus from 20 bodies at autopsy including all the tissue from the peritoneum through the skin were cut longitudinally as 1/4 inch thick sections (d) similar blocks were taken at a right angle to the mid-rectus incision both above and below the umbilicus

Brief histories of these 3 cases are:

CASE G. K., S. M. H. No. 109, 66, 60 year old, white male was admitted November 30, 1941, with symptoms of urinary extravasation and respiratory infection with cough of 6 days duration prior to admission. His abdomen was reddened with subjunctive swelling from the symphysis to the umbilicus, more marked on the right than the left side. His penis was gangrenous and tender; the scrotum was swollen, red, and tender. The patient was sent to the operating room immediately. The gangrenous areas of the penis were removed. Multiple incisions were made into the perineum, penis, scrotum, and abdomen, and drained. He died 7 days after admission with clinical diagnosis of lobar pneumonia as the cause of death. The emaciated body was subsequently sent to the Department of Anatomy for embalming and dissection. Samples of tissue were taken from the areolar areas involved in the extravasation for microscopic study. This case was also used in previous study (Tobin and Benjamin, 1944).

the scrotum which required secondary closure and prolonged his hospitalization. He was discharged as cured on June 9, 1947.

CASE J. W. A., R. G. H., No. A 24333 R, 74 year old, white male was admitted December 2, 1947 with pain and soreness in lower abdomen and locomotion for previous 24 hours. His penis was markedly swollen and gangrenous and leaking urine from fistula on the ventral surface. His scrotum and perineum were red and swollen. The patient was taken to the operating room for debridement of the penis and scrotum and for a

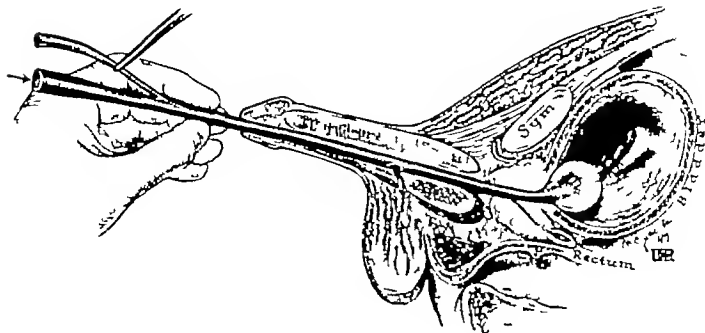


Fig. 1 Drawing to illustrate the method for producing simulated extravasation from the penile urethra. A sagittal section of the pelvis and perineum is shown for clarity. The penile urethra was visualized by means of a McCarthy panendoscope through which a fulgurating electrode was inserted to perforate the ventral wall of the urethra (at approximately 1 inch distal to the external sphincter) the corpus spongiosum urethrae bulbocavernosus muscle and its covering of Buck's fascia. The panendoscope and electrode were withdrawn and a modified Foley catheter with

the "bladder openings" ligated and its lumen perforated to correspond to the level of fulguration was then inserted through the penile urethra and into the bladder. The balloon was inflated and retracted against the bladder neck. The air passage of the catheter was compressed with a bismat to keep the balloon inflated. Compressed air followed by a diluted rubber solution (red or yellow liquid latex) was then injected via the catheter into the tissues of perineum to simulate course of extravasation. Arrows indicate pathway of injection mass. 0.75 normal size.

from 2 adult male bodies and were prepared in the same manner as the sections from (c) and (e) 4 samples (1 to 2 inches wide and 3 inches long) of the skin, subcutaneous tissue and underlying muscle or fascia from the lateral surface of the thigh arm and back were similarly prepared to compare the structure of the subcutaneous tissue in these regions with that of the abdominal wall from the bodies used in (d). These macroscopic sections were stained with aniline blue to demonstrate the form relations and connections of the collagenous strands or bands which make up most of the membrane-like layer over relatively large areas of the subcutaneous tissue.<sup>4</sup>

3 Gross dissections of the regions under consideration were also studied in 30 adult male cadavers in the dissecting rooms and photographs taken of the dissected subcuta-

neous tissue in some specimens to verify the conclusions drawn from the stained microscopic or macroscopic sections.

4 Cases of urinary extravasation were also utilized. In addition to the microscopic sections from the 3 real cases of extravasation mentioned before this type of extravasation was simulated in 10 cadavers by perforating the ventral wall of the penile urethra (approximately 1 inch distal to the external sphincter) the corpus spongiosum and its tunica albuginea, the bulbocavernosus muscle and its covering of Buck's fascia by means of a fulgurating electrode introduced through the urethra via a McCarthy panendoscope to visualize and direct the depth of perforation. Following this simulated perforation a Foley (24 or 26 French) catheter was inserted into the penile, membranous and prostatic urethra and for a short distance into the bladder. This catheter had been modified before insertion so that the

<sup>4</sup>See Tobin and Rumery (1948) for a more detailed account of the preparation and staining of such macroscopic sections.

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Brief histories of these 3 cases are:

CASE 1. O. K., S. M. H. N. 9906, 60-year-old, white male was admitted November 30, 1942 with symptoms of urinary extravasation and respiratory infection with cough of 8 days duration prior to admission. His abdomen was redness with subcutaneous swelling from the epiphrase to the umbilicus, more marked on the right than the left side. His penis was gangrenous and tender; the scrotum was swollen, red, and tender. The patient was sent to the operating room immediately. The gangrenous areas of the penis were removed. Multiple incisions were made into the perineum, penis, scrotum, and abdomen, and drained. He died 7 days after admission with clinical diagnosis of lobar pneumonia as the cause of death. The unclaimed body was subsequently sent to the Department of Anatomy for embalming and dissection. Samples of tissue were taken from the various areas involved in the extravasation for microscopic study. This case was also used in previous study (Tobin and Benjamin, 1944).

CASE 2. E. G., R. M. H. N. 30324, 43-year-old, white male was admitted April 20, 1947 with chills and fever prior to the groin, scrotum, and perineum which had been swollen and tender 4 days prior to admission. The next day his perineum, scrotum, penis, and lower abdominal wall were red and swollen with typical outline of extravasation from the penile urethra, but he had no difficulty urinating. Multiple incisions were made into the scrotum, penis, base of the involved areas and drained. A sample of skin and subcutaneous tissue was taken as inch above the fold part of the left inguinal ligament for microscopic study. A diagnosis of urinary extravasation with bacterial infection of these areas was made. There was sloughing of the tissues particularly over

cut at 10 micra in paraffin and were stained with Heidenhain's modification of the Mallory connective tissue stain. Other samples of the same tissues were also cut in celloidin or with the freezing microtome and stained with hematoxylin and eosin orcein (for elastic fibers) or the Heidenhain's connective tissue stain. In addition Sudan IV or Sudan black B were used as fat stains on selected sections.

2. Macroscopic sections were also made since the amount of tissue which can be cut in paraffin and celloidin or with the freezing microtome is so limited and hence the continuity and attachments of the connective tissue layers is interrupted by these methods. These macroscopic sections were made by embalming the larger specimens with or immersing the smaller ones into 10 per cent formalin and subsequently freezing them with dry ice (solid CO<sub>2</sub>). Such specimens consisted of (a) a portion of the body including the lower abdomen, pelvis and thigh from 5 full term male fetuses which were cut on a Vaughan high speed band saw (3 cut in the sagittal and 2 in the coronal plane) as 3/8 inch thick sections (b) comparable regions from 5 adult males similarly prepared and cut (3 in the sagittal and 2 in the coronal plane) as 3/8 inch thick sections (c) segments of the ventral abdominal wall approximately 3 to 5 inches long and 1 to 2 inches wide, taken parallel to the mid rectus incision distal to the umbilicus from 20 bodies at autopsy including all the tissue from the peritoneum through the skin were cut longitudinally as 3/8 inch thick sections (d) similar blocks were taken at a right angle to the mid rectus incision both above and below the umbilicus

the scrotum which required secondary closure and prolonged hospitalization. He was discharged as cured on June 1947.

CASE 3. W. A., R. G. H. N. A. 4333 R, 74-year-old, white male was admitted December 15, 1947 with pain and soreness in lower abdomen and locomotion for previous 24 hours. His penis was markedly swollen and painless and leaking urine from urethra on the central surface. His scrotum and perineum were red and distended, with involvement of the abdominal wall from the pubis to the umbilicus and laterally to the iliac crests and for an inch below the inguinal ligaments, as well as in the anterior part of the abdominal wall, along the sides of the anus. A suprapubic cystostomy was done. Multiple drainage incisions were made into the subcutaneous tissue of the involved areas and drains were placed there. A sample of the skin and subcutaneous tissue was taken, both distal and lateral to the umbilicus from the right side for microscopic study. There was considerable sloughing of skin and subcutaneous tissue from the involved areas, which required prolonged hospitalization. He had similar extravasation about 10 years previously due to an injury of his perineum. He was discharged February 1948, after unilateral orchiectomy and plastic repair of the penis.

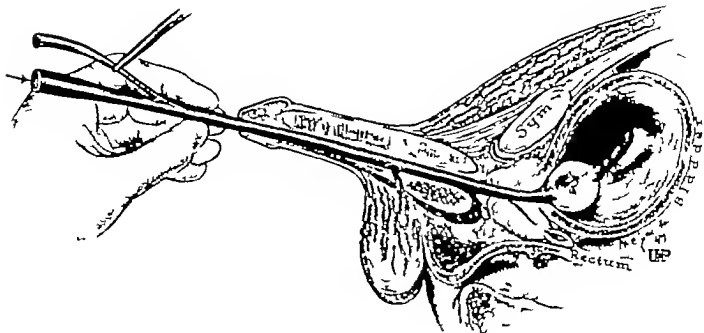


Fig. 1. Drawing to illustrate the method for producing simulated extravasation from the penile urethra. A sagittal section of the pelvis and perineum is shown for clarity. The penile urethra was visualized by means of a McCarthy panendoscope through which a fulgurating electrode was inserted to perforate the ventral wall of the urethra (at approximately 1 inch distal to the external sphincter) the corpus spongiosum urethrae, bulbocavernosus muscle and its covering of Buck's fascia. The panendoscope and electrode were withdrawn and a modified Foley catheter with

the bladder openings<sup>2</sup> ligated and its lumen perforated to correspond to the level of fulguration was then inserted through the penile urethra and into the bladder. The balloon was inflated and retracted against the bladder neck. The air passage of the catheter was compressed with a hemostat to keep the balloon inflated. Compressed air followed by a diluted rubber solution (red or yellow liquid latex) was then injected via the catheter into the tissues of perineum to simulate course of extravasation. Arrows indicate pathway of injection mass. 0.75 normal size.

from 2 adult male bodies and were prepared in the same manner as the sections from (c) and (e) 4 samples (1 to 2 inches wide and 3 inches long) of the skin subcutaneous tissue and underlying muscle or fascia from the lateral surface of the thigh arm and back were similarly prepared to compare the structure of the subcutaneous tissue in these regions with that of the abdominal wall from the bodies used in (d). These macroscopic sections were stained with aniline blue to demonstrate the form relations and connections of the collagenous strands or hands which make up most of the membrane-like layer over relatively large areas of the subcutaneous tissue.<sup>4</sup>

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<sup>2</sup>See Tobin and Rumery (1948) for more detailed account of the preparation and staining of such macroscopic sections.

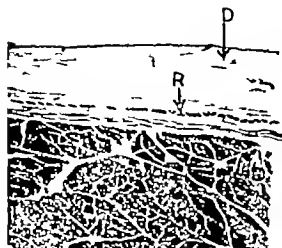


Fig. 3.

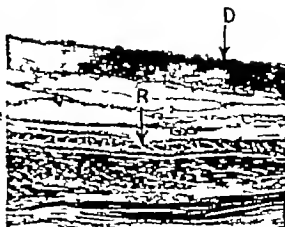


Fig. 4.

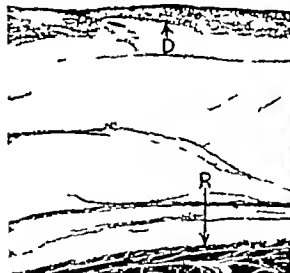


Fig. 5.

Fig. 3. Photomicrograph of a paraffin section through the abdominal wall, taken such lateral and distal to the umbilicus, from an emaciated adult male. The subcutaneous tissue consists of strands of collagenous and elastic fibers around deposits of fat (clear areas) between the dermis, *D*, and the sheath of the rectus abdominis muscle, *R*. The collagenous fibers in the inner part of the subcutaneous tissue immediately above the rectus sheath might possibly be interpreted as membranous layer in this section. Compare with Figures 3 and 4. Heidenhain connective tissue stain.  $\times 90$ .

Fig. 4. Photomicrograph of a paraffin section, through the abdominal wall from an obese adult male of average obesity. Note the increased amount of fat (clear areas) between collagenous and elastic fibers and no suggestion of definite inner membranous layer in the subcutaneous tissue. Slit from which section was taken. The stain used, and the labels are the same as for Figure 3.  $\times 90$ .



Fig. 5.

Fig. 4. Photomicrograph of a paraffin section, through the abdominal wall from an obese adult male. The laminated structure of the fat is surrounded by collagenous and elastic fibers. In the subcutaneous tissue does not suggest any division of this tissue into an outer fatty and an inner membranous layer. Slit from which this section was taken, the stain used, and the labels are the same as for Figure 3.  $\times 90$ .

Fig. 5. Photograph of a macroscopic, frozen section cut in the longitudinal plane through the paramedian region of the abdominal wall from an obese, adult male. Collagenous tissue was stained with indigo blue. Note that the subcutaneous tissue between the dermis, *D*, and the rectus abdominis muscle and sheath, *R*, consists of collagenous fibers around the alveoli of fat. As demonstrated in Figures 3 and 4, there is no subdivision of the subcutaneous tissue into an outer fatty layer and an inner membranous layer.  $\times 60$ .

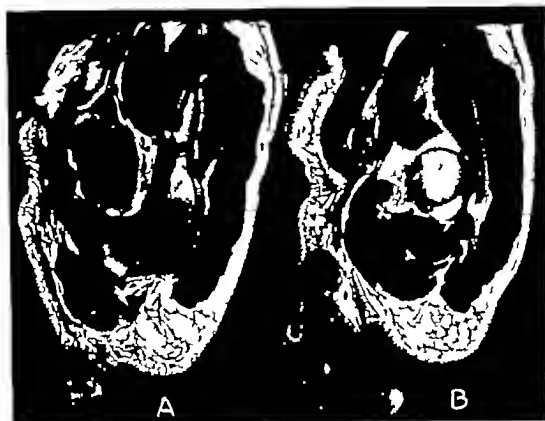


Fig. 6 Photograph of macroscopic, frozen sections cut slightly obliquely in the sagittal plane through the pelvic area of a full term male infant. Collagenous tissue in these sections was stained with aniline blue. Note the strands of collagenous fibers around the fat deposits in the subcutaneous tissue in both sections A and B with no separation of this tissue into an outer fatty and an inner membranous layer over the abdominal wall or over the perineum.  $\times 0.8$ .

bladder openings were ligated and other apertures made into the lumen of the catheter to correspond to the fulgurated perforation. The balloon was then inflated and retracted against the bladder neck with considerable force to prevent the injection mass from entering the bladder. Compressed air followed by an injection mass red or yellow liquid latex was then injected into the catheter so this mass could simulate the course of extravasation (Fig. 1). These cadavers were afterwards embalmed via the femoral artery with 10 per cent formalin. Subsequently 3 of these cadavers were studied by progressive stages of dissection to determine the layers involved in this simulated extravasation whereas the lower abdomen, pelvis and thigh of the other 7 were frozen in dry ice and cut into sections (1 to 1½ inches thick) on a band saw either in the sagittal or coronal plane to avoid interrupting the layers which result when dissection is used as a means of study. These sections were used to observe the course of the simulated extravasation.

#### OBSERVATIONS

*Anatomical* There was no evidence of a subdivision of the subcutaneous tissue over the ventral abdominal wall and the perineum into an outer fatty (Camper's) and an inner membranous (Scarpa's-Colles') layer for this tissue in both microscopic and macroscopic sections of newborn and adult male specimens consisted of a single layer composed of collagenous and elastic fibers in the form of sheets or bands enclosing deposits of fat (Figs. 2 through 11). The subcutaneous tissue over the penis and scrotum consisted of a loose network of collagenous and elastic fibers in which isolated bundles of smooth muscle (dartos) fibers were embedded. The cutaneous nerves, superficial vessels, lymph nodes (Figs. 7 and 9) and vessels were embedded in this one common continuous layer and not embed-

\*Collagenous fibers made up the greater part of the sheets or bands enclosing the deposits of fat, although elastic and reticular fibers were also present in much smaller amounts. Therefore in the subsequent discussion, the term "fibers" will be used to refer to the collagenous fibers.

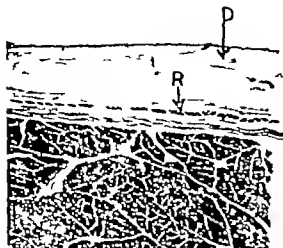


Fig. 2.

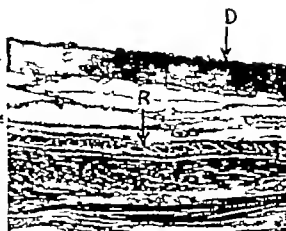


Fig. 3.

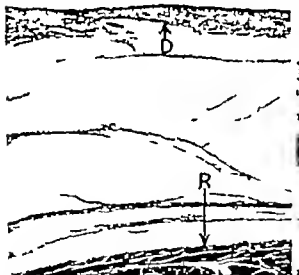


Fig. 4.

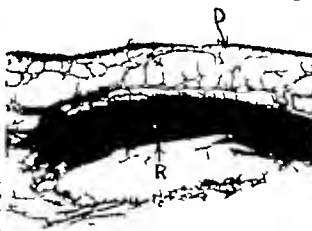


Fig. 5.

Fig. 2. Photomicrograph of a paraffin section through the abdominal wall taken one inch lateral and distal to the umbilicus, from an emaciated adult male. The subcutaneous tissue consists of strands of collagenous and elastic fibers around deposits of fat (clear areas) between the dermis, *D* and the sheath of the rectus abdominis muscle, *R*. The collagenous fibers in the inner part of the subcutaneous tissue immediately above the rectus sheath might possibly be interpreted as a membranous layer in this section. Compare with Figures 3 and 4. Heidenhain connective tissue stain.  $\times 90$ .

Fig. 3. Photomicrograph of a paraffin section through the abdominal wall from an adult male of average obesity. Note the increased amount of fat (clear areas) between collagenous and elastic fibers and no suggestion of a definite inner membranous layer in the subcutaneous tissue. Site from which section was taken. The stain used and the labels are the same as for Figure 2.  $\times 90$ .

Fig. 4. Photomicrograph of a paraffin section through the abdominal wall from an obese adult male. The laminated structure of the fat surrounded by collagenous and elastic fibers in the subcutaneous tissue does not suggest any division of this tissue into an outer fatty and an inner membranous layer. Site from which this section was taken, the stain used, and the labels are the same as for Figure 2.  $\times 90$ .

Fig. 5. Photograph of a macroscopic frozen section cut in the longitudinal plane through the paramedian region of the abdominal wall from an obese adult male. Collagenous tissue, as stained with aniline blue. Note that the subcutaneous tissue between the dermis, *D* and the rectus abdominis muscle and sheath, *R*, consists of collagenous fibers around the alveoli of fat. As demonstrated in Figures 2 to 4, there is no subdivision of the subcutaneous tissue into an outer fatty layer and an inner membranous layer.  $\times 0.6$ .



Fig. 6. Photograph of macroscopic, frozen sections cut slightly obliquely in the sagittal plane through the pelvic area of a full term male infant. Collagenous tissue in these sections was stained with aniline blue. Note the strands of collagenous fibers around the fat deposits in the subcutaneous tissue in both sections A and B with no separation of this tissue into an outer fatty and an inner membranous layer over the abdominal wall or over the perineum.  $\times 0.8$ .

bladder openings were ligated and other apertures made into the lumen of the catheter to correspond to the fulgurated perforation. The balloon was then inflated and retracted against the bladder neck with considerable force to prevent the injection mass from entering the bladder. Compressed air followed by an injection mass red or yellow liquid latex was then injected into the catheter so this mass could simulate the course of extravasation (Fig. 1). These cadavers were afterwards embalmed via the femoral artery with 10 per cent formalin. Subsequently 3 of these cadavers were studied by progressive stages of dissection to determine the layers involved in this simulated extravasation whereas the lower abdomen, pelvis and thigh of the other 7 were frozen in dry ice and cut into sections (1 to 1½ inches thick) on a band saw either in the sagittal or coronal plane to avoid interrupting the layers which result when dissection is used as a means of study. These sections were used to observe the course of the simulated extravasation.

#### OBSERVATIONS

*Anatomical.* There was no evidence of a subdivision of the subcutaneous tissue over the ventral abdominal wall and the perineum into an outer fatty (Camper's) and an inner membranous (Scarpa's-Colles') layer, for this tissue in both microscopic and macroscopic sections of newborn and adult male specimens consisted of a single layer composed of collagenous and elastic fibers\* in the form of sheets or bands enclosing deposits of fat (Figs. 2 through 11). The subcutaneous tissue over the penis and scrotum consisted of a loose network of collagenous and elastic fibers in which isolated bundles of smooth muscle (dartos) fibers were embedded. The cutaneous nerves, superficial vessels, lymph nodes (Figs. 7 and 9) and vessels were embedded in this one common continuous layer and not embed-

\*Collagenous fibers made up the greater part of the sheets or bands enclosing the deposits of fat, although elastic and reticular fibers were also present in much smaller amounts. Therefore in the subsequent discussion, the term "fibers" will be used in reference to the collagenous fibers.





Fig. 7. Photograph of macroscopic sections from the same specimen shown in Figure 6 and cut and stained by the same methods. *A* Note the continuity of the superficial collagenous fibers in the subcutaneous tissue over the iliofemoral vein on the thigh, hence the deeper fibers are attached to the fascia lata, and in *B* the direction of the collagenous fibers parallel the ischiofemoral foramen around the rectum. *C* Compare the direction of the latter fibers with those over the perineum shown in Figures 6 *A* and *B*. The location of the inguinal lymph nodes, *LN*, and the subcutaneous layer is shown.  $\times 8$ .

ded within a fatty layer between a fatty and membranous layer or deep to a definite membranous layer in the lower abdominal, penile, scrotal and perineal regions. In dissections of these regions a cleavage plane could be made along any one of the several sheets or bands of fibers around the fatty alveoli in addition to the artificially created membrane-like layer in the inner part of the subcutaneous tissue (Figs. 12 and 13).

The subcutaneous tissue in these regions was continuous with that in adjacent areas of the body and had the same structure. However the direction, the extent, and the attachment of the collagenous fibers to the deep fascia and periosteum of the body wall were related to the degree of movement possible in the overlying skin. Where considerable movement was possible the course of the fibers was mainly parallel to the skin and in the form of laminae made up of strands or bands several inches in length (Figs. 5, 6 and 9). In such areas only areola like fibers attached the sub-

cutaneous tissue to the subjacent body wall. In the midline distal to the umbilicus the deeper fibers were thickened to form the suspensory ligament of the penis. Cephalad to this ligament there was no evidence of a definite partition formed in the midline by a continuous attachment of fibers to the linea alba which would create two lateral compartments over the ventral abdominal wall to limit the spread of extravasates to either side exclusively. However at the junction of the inferior extremity with the pelvis the fibers were very firmly fused to the deep fascia or periosteum of the body wall. Many of these fibers were attached to the inguinal ligament or to the fascia lata of the thigh. A smaller superficial (subdermal) group of fibers surrounding deposits of fat continued in their course down the thigh (Figs. 7, 9 and 22). In the perineum the fibers were connected laterally to the periosteum of the inferior ramus of the pubis and ischium (Figs. 10 and 22). There was a weak attachment of these fibers to the midline over



Fig 8 Photograph of a macroscopic, frozen section cut in the coronal plane through the perineum of a newborn male infant. Note the arrangement of the collagenous strands stained with aniline blue between the components of the penis, *P* and the skin of the perineum. There is no definite layer which could be designated as a membranous (Colles') layer.  $\times 0.9$ .

Buck's fascia covering the bulbocavernosus muscle but this attachment was not as firm as that to the ramus of the pubis and ischium. At the posterior border of the urogenital triangle the majority of these fibers coursed cephalad into the ischiorectal fossa and were at approximately a right angle to those superficial to the Buck's fascia over the 3 components of the penis in the perineum (Figs 6, 7, 8, 10, 11 and 22). There was no evidence that these fibers attached to the posterior border of the urogenital diaphragm.

**Clinical.** The finding of one and not two separate (outer fatty and inner membranous) layers of subcutaneous tissue in the anatomic observations was verified from sections of the tissue designated as the membranous (Scarpa's) layer removed from the abdominal wall at operation. Such tissue consisted of strands or sheets of collagenous fibers embedded in or surrounding fat (Fig 14) and not a distinct membranous layer. Sections of the skin and subcutaneous tissue from the 3 cases of urinary extravasation also showed that the extravasate was within the subcutaneous laminae formed by the sheets or strands of fibers around the lobules or alveoli of fat (Figs 15, 16 and 17) and not limited by an inner membranous layer nor deep to the whole subcutaneous layer—between it and the intrinsic fas-



Fig 9 Photograph of a macroscopic, frozen parasagittal section through the pelvis and thigh of an adult male. Collagenous tissue stained with aniline blue. Note the structure of the collagenous fibers around the deposits of fat in the lower abdominal region and the continuity of the superficial fibers on the thigh, whereas many of the deeper fibers are connected to this ligament *IL*. Superficial nerves, blood vessels, lymph nodes, *LN*, and vessels are embedded within this single layer of fat and collagenous fibers and not between an outer fatty and an inner membranous layer.  $\times 0.18$ .

ciae covering the muscles of the body wall. In some instances extravasates may probably be found in such a location but from these 3 real cases and the 10 simulated cases of extravasation it seems unlikely that this is the usual pathway for in all the simulated cases the injection mass was within and not deep to the subcutaneous layer (Figs 18, 19, 20 and 21). The extravasate followed the course of the fibrous sheets or bands around the fat deposits and infiltrated the subcutaneous layer from the body wall to the dermis (Figs 15 through 21).

The loose "areola like" layer of collagenous and elastic tissue in the scrotum and penis was infiltrated readily with the injection mass (Figs 18, 19, 20 and 21). This mass was also found in the subcutaneous tissue between the

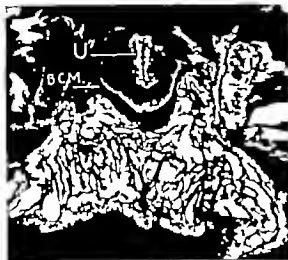


Fig. 10.



Fig. 11.



Fig. 12.

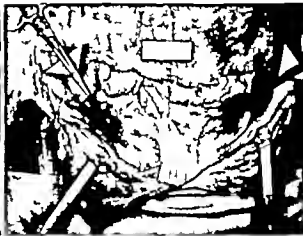


Fig. 13.

Fig. 10. Photograph of macroscopic, frozen section, cut in the coronal plane through the perineum of an adult male. Collagenous fibers are stained with aniline blue. Note the absence of definite membranous layer between the bulbocavernosus muscle, BCM, around the corpus spongiosum urethrae containing the urethra, U, and the skin of the perineum. Many of these collagenous strands connect the perineum of the inferior ramus of the pubis and lachium. There is loose attachment of the collagenous fibers to Buck's fascia covering the bulbocavernosus muscle.  $\times 88$ .

Fig. 12. Photograph of macroscopic, frozen section cut slightly obliquely in the coronal plane through the lachryrectal fossa of the same specimen shown in Figure 10. Note the cephalic direction of the collagenous strands stained with aniline blue around the deposits of fat in the lachryrectal fossa on each side of sphincter and externus muscle, S. These strands are approximately at right angles to those collagenous strands which lie over the components of the penis in the urogenital triangle. Compare with Figures 8 and 9.  $\times 44$ .

Fig. 13. Photograph of dissection of the subcutaneous tissue over the ventral abdominal wall showing the inner membranous layer (Scarpa's fascia) dissected by the students in gross anatomy. The skin has been reflected and the usual concept of the superficial fatty layer (Camper's fascia) dissected from the inner membranous layer and reflected laterally. Hemostats are elevating the "membranous layer" from the deep fascia over the psoas muscle of the external oblique muscles. The suspensory ligament of the penis is shown in the midline between the reflected flaps of the fatty layer.  $\times 0.5$ .

Fig. 14. Photograph of the same specimen shown in Figure 13. Hemostats are elevating the dissected "inner membranous" layer but an additional membranous layer superficial to that dissected by the students, is shown over the handles of the forceps in the lower part. Three such membranous layers are found in this specimen of average obesity indicating that dexterity with scalpel can create membranous layers in different depths of subcutaneous tissue. Compare with Figures 5 and 6 for collagenous strands which may be utilized as cleavage lines in dissection.  $\times 0.5$ .



Fig. 14. Photomicrograph of the tissue designated as Scarpa's fascia, removed from the subcutaneous tissue approximately an inch cephalad to the midpoint of the inguinal ligament, during repair for inguinal hernia in an adult male. This sample of Scarpa's fascia consists of layers of collagenous fibers surrounding fat and blood vessels and is not a distinct membranous layer. Heidenhain's connective tissue stain.  $\times 9$ .



Fig. 15. Photomicrograph of a section through the ventral abdominal wall approximately an inch cephalad to the midpoint of the inguinal ligament from the embalmed cadaver of an adult male who had urinary extravasation from the penile urethra. (See Case 1 in footnote.) This section was cut on the freezing microtome and stained with Sudan black B to show the deposits of fat in the necrotic tissue on each side of the path of extravasation. The extravasate was not deep to a membranous (Scarpa's) layer but within the one common layer of subcutaneous tissue. The gap in the left side of this section is part of the original drainage incision in the subcutaneous tissue. Part of the epidermis was sloughed off. Note its absence over the dermis D in certain areas. The aponeurosis of the external oblique muscle is labelled, E.  $\times 65$ .

dermis and Buck's fascia along the shaft of the penis and in the subcutaneous layer over the ventral abdominal wall. Except in 1 instance the simulated extravasate did not extend further distally than 1 inch below the inguinal ligament. In several cadavers it did extend into the superficial part of the subcutaneous tissue around the anus but not more than a half inch into the ischioanal fossa (Fig. 18).

It is well known that extravasates through the penile urethra entering the vascular corpus spongiosum urethrae introduce urine, bacteria, and other matter into the vascular system. Subsequent infiltration of the subcutaneous tissue occurs after the extravasate has spread through the coverings of the corpus spongiosum urethrae and Buck's fascia. These studies with simulated extravasation wherein the colored injection mass imitated the course of the urine indicate that the extravasate may follow additional courses which could not readily be visualized in true cases of extravasation except those of several days' duration in which local inflammation of the tissue would delineate the course. For example, as the simulated extravasate courses within the subcutaneous layer it may infiltrate the loose areolar tissue around the walls of cutaneous vessels and nerves and follow retrogradely along their course to enter between the layers of the abdominal wall. The point of attachment of the testes to the lower part of the scrotal sac also consists of loose areolar tissue. The simulated extravasate in 8 of the 10 experi-

mental extravasations was found to pass through this areolar tissue and to enter within the layers of the spermatic cord. Via this route it coursed retrogradely upward within the spermatic cord (Fig. 20), through the inguinal canal in cases where inguinal hernia had distended the canal (Fig. 21) and infiltrated the retroperitoneal tissue of the abdomen.

In many clinical cases following rupture of the mucous membrane in the penile urethra the vascular erectile tissue of the corpus spongiosum urethrae may be infiltrated with the extravasate before subsequent rupture of the tunica albuginea, bulbocavernosus muscle and its covering of Buck's fascia result in infiltration of the subcutaneous tissue in this area. In other cases the mucous membrane of the penile urethra may form a sinus tract through the erectile tissue and its coverings. The extravasate in such cases would involve the subcutaneous tissues only and by means



Fig. 6 (left). Photomicrograph of a paraffin section of the skin and subcutaneous tissue removed from the area immediately above the left inguinal ligament from a patient with urinary extravasation from the penile urethra (See Case 3 in footnote 1) at the time of surgical drainage of the areas of extravasation. Note from the dermis, *D* inward, the extravasated urine, bacteria, and blood cells followed the course of the collagenous fibers surrounding the alveoli of fat as shown by the dark stained material along the fibers. Heidenhain's connective tissue stain.  $\times 8$ .

Fig. 7. Photomicrograph of a paraffin section of the skin and subcutaneous tissue removed from an area 1 inch lateral and distal to the umbilicus from the right side of a patient at the time of surgical drainage of the areas involved in urinary extravasation from the penile urethra (See Case 3 in footnote 1). Note in Figure 6, the extravasate followed along the collagenous fibers surrounding the deposits of fat and extended 1 cm under surface of dermis, *D*. Also note position of cutaneous vessels, *CV*, within subcutaneous fat. Heidenhain's connective tissue stain.  $\times 8$ .

of this tract by pass the erectile tissue. To test whether the method used in the simulated extravasation studies would involve the same tissues as those in the clinical cases with sinus tract formation liquid latex was injected directly into the subcutaneous tissue over the perineal components of the penis in 2 cadavers. This injection mass was found to follow the same pathways as those described above for the simulated extravasations from the perforated penile urethra. In other studies the

injection mass when injected into the subcutaneous tissue above the pubic symphysis likewise filled the same areas in 2 cadavers. Finestone (1941) has made similar studies using a radiopaque injection mass and found the tissue involved to be the same as we have described.

#### DISCUSSION

Although the subcutaneous tissue in most regions of the body is described as consisting of only one layer that in the region of the low

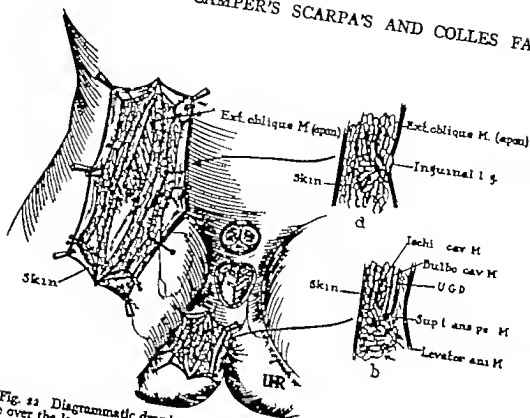


Fig. 22 Diagrammatic drawing to illustrate the structure of the subcutaneous tissue over the lower abdominal wall, proximal part of the thigh, and the perineum. For simplicity the shaft of the penis and the scrotum are shown only as cross sections through their bases. The skin and the layers which can be dissected in the subcutaneous tissue proximal and distal to the inguinal ligament are shown in the left side of this diagram. A cross section from the same area is shown in inset a. Note, as shown by the arrows in the insert a, and the lines in the dissected area, that the majority of the fibers around the deposits of fat pass from one lamina (of fat and fibers) to the next subjacent layer. The fibers are attached to the inguinal ligament or to the fascia lata distal to this ligament. A smaller finer group of fibers and fat, immediately beneath the skin continue directly from the lower abdominal area onto the thigh. The composition of the subcutaneous tissue in the perineum is shown by a dissection and a cross section (insert b). In the dissection several layers could be created in the subcutaneous tissue and, as indicated by the arrows in the insert b, the majority of the fibers course parallel to the skin and the components of the penis in the inguinal triangle of the perineum. However these fibers are continuous with similar fibers in the ischiofemoral fossa of the anal triangle, but in the latter location they run at approximately a right angle to those over the urogenital triangle. These fibers did not have a definite attachment to the superficial transverse perineal muscle nor to the posterior border of the urogenital diaphragm, U.G.D. There was no evidence of a division of the subcutaneous tissue in the perineum thigh, or lower abdomen into a definite outer fatty and inner membranous layers. Compare with Figures 9, 10 and 21 for the structure of the subcutaneous tissue in these areas as seen in stained sections. X 35

er abdominal wall and in the perineum has been thought to be subdivided anatomically and clinically into an outer fatty and an inner membranous layer. It is interesting to note that approximately 90 years elapsed after Camper Scarpa and Colles published their respective works from which the terms now used for the layers of the subcutaneous tissue in these regions might have been taken before their names were introduced into the anatomic and clinical texts. Before that time most of the texts stated that only one layer was present

and only a few years before these proper names were introduced in the texts were two layers assumed to be in the subcutaneous tissue. It is most likely if these layers were present anatomists and clinicians at that time would have observed them. The evidence presented in this present work indicates that the older idea of one subcutaneous layer in the regions involved in extravasates from the penile urethra should be adopted again in keeping with the same structure of this tissue in the body.

The question may be raised what governs and directs the classical spread of such extravasates if there is only one layer present in the perineum scrotum penis and abdominal wall, which is continuous with the general subcutaneous layer in other parts of the body. The attachments of the collagenous fibers in the subcutaneous tissue to deeper structures at certain areas (such as the inguinal ligament or adjacent fascia lata—Figs. 9 and 22—and the inferior rami of the pubis and ischium—Figs. 10 and 22—together with changes in direction of these fibers in certain areas as in the ischiorectal fossa—Figs. 6, 8, 10, 11 and 22) can account for the limitations. Differences in the structure of this tissue (areolar in the scrotum and around the penis, and fibrous strands surrounding fat in the form of loose laminae parallel to the surface of the skin over the perineum—Figs. 6, 8 and 10—and ventral abdominal wall—Figs. 2, 3, 4, 5, 6, 7 and 9) can account for its ease of spread in the typical directions. In some cases extravasated blood from injury in the perineum has been known to follow not only this typical course but also to extend into the subcutaneous tissue over the thigh and posteriorly along the sides of the rectum in the superficial part of the ischiorectal fossa.

Drainage incisions for extravasates are usually made to a depth which penetrates the whole of the subcutaneous layer. Yet it is known that in many instances the extravasate may be encountered in the superficial part of the subcutaneous tissue once the dermis is incised and such material may be found within the entire thickness of the subcutaneous tissue although in certain early cases the extravasate may be mainly in the deeper part of this tissue before infiltration of the more superficial part has occurred. In the closure of incisions in these areas the entire depth of the subcutaneous tissue does not have to be entered before collagenous and elastic fibers are encountered for they are found even in the superficial part of this so called fatty layer (Figs. 2, 3, 4, 5, 16, 17 and 22).

As pointed out above unless the case of true extravasation is one of comparatively long standing wherein the inflammation within this tissue would outline the course of the

extravasate little can be known of its exact or probable extent. The information gained from these simulated extravasation studies suggests that the extravasate may involve other tissues than those usually described in real cases of extravasation. Extravasates may also course retrogradely within the areolar tissue along the sides of the superficial vessels and cutaneous nerves to enter between the layers of the abdominal wall or within the layers of the spermatic cord in addition to passing within the superficial part of the subcutaneous tissue down the front of the thigh or in the ischiorectal fossa.

The concept of one layer of collagenous and elastic fibers around deposits of fat and not two distinct layers (an outer fatty and an inner membranous) in the subcutaneous tissue has been recognized for many years. Langer (1861), Kocher (1907) and Cox (1941) suggested a similar structure for the subcutaneous tissue and showed that the cleavage lines of the skin are related to the direction of the fibers in this tissue as well as their connection to the deep fascia or perosteum in certain areas.

There appears to be no justification for the concept of an outer fatty (Camper's) and an inner membranous (Scarpa's-Colles') fascia in the subcutaneous tissue from historical priority of definition, anatomic structure, or the involvement of this tissue in real or simulated cases of urinary extravasation. This erroneous concept was introduced into the medical literature through sources as yet unidentified and has been perpetuated by tradition and inadequate means of study. The authors (Tobin and Benjamin, 1944 and 1946) also conformed to the usual concept of the form and attachments of these layers when dissection was used as a means of approaching such problems.

#### SUMMARY

The present concept of an outer fatty (Camper's) and an inner membranous (Scarpa's-Colles') fascia in the subcutaneous tissue over the ventral abdominal wall and in the perineum and their role in directing and limiting the spread of extravasates are not justified for the following reasons:

1. There are many inconsistencies in the anatomic texts as to the structure and continu-

ity of these layers and their relation to the cutaneous nerves and vessels which may be due to the fact that no priority of definition could be found for these fasciæ since Camper, Scarpa, and Colles did not describe these layers as they are currently defined

2 Studies from microscopic and macroscopic sections from these regions show that the subcutaneous tissue is made up of only one layer—strands or sheets of collagenous and elastic fibers surrounding deposits of fat which is similar to the structure of this tissue in other areas of the body

3 Sections taken from and dissections made of real and simulated cases of extravasation from the penile urethra demonstrate that the extravasates are within the one common layer and not limited by a deep membranous (Scarpa's-Colles') layer. The attachment of the collagenous and elastic fibers to the deep fascia or perosteum of the body wall as well as the change in direction of these fibers and the compactness or looseness of the one subcutaneous layer account for the direction and limitation of the spread of extravasates

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The question may be raised what governs and directs the classical spread of such extravasates if there is only one layer present in the perineum scrotum penis and abdominal wall which is continuous with the general subcutaneous layer in other parts of the body. The attachments of the collagenous fibers in the subcutaneous tissue to deeper structures at certain areas (such as the inguinal ligament, or adjacent fascia lata—Figs. 9 and 22—and the inferior rami of the pubis and ischium—Figs. 10 and 22—together with changes in direction of these fibers in certain areas as in the ischiorectal fossa—Figs. 6 7 8 10 11 and 22) can account for the limitations. Differences in the structure of this tissue (areolar in the scrotum and around the penis and fibrous strands surrounding fat in the form of loose laminae parallel to the surface of the skin over the perineum—Figs. 6 8 and 10—and ventral abdominal wall—Figs. 2 3 4 5 6 7 and 9) can account for its ease of spread in the typical directions. In some cases extravasated blood from injury in the perineum has been known to follow not only this typical course but also to extend into the subcutaneous tissue over the thigh and posteriorly along the sides of the rectum in the superficial part of the ischiorectal fossa.

Drainage incisions for extravasates are usually made to a depth which penetrates the whole of the subcutaneous layer. Yet it is known that in many instances the extravasate may be encountered in the superficial part of the subcutaneous tissue once the dermis is incised, and such material may be found within the entire thickness of the subcutaneous tissue although in certain early cases the extravasate may be mainly in the deeper part of this tissue before infiltration of the more superficial part has occurred. In the closure of incisions in these areas the entire depth of the subcutaneous tissue does not have to be entered before collagenous and elastic fibers are encountered for they are found even in the superficial part of this so called fatty layer (Figs. 2 3 4 5 16 17 and 22).

As pointed out above unless the case of true extravasation is one of comparatively long standing wherein the inflammation within this tissue would outline the course of the

extravasate little can be known of its exact or probable extent. The information gained from these simulated extravasation studies suggests that the extravasate may involve other tissues than those usually described in real cases of extravasation. Extravasates may also course retrogradely within the areolar tissue along the sides of the superficial vessels and cutaneous nerves to enter between the layers of the abdominal wall or within the layers of the spermatic cord in addition to passing within the superficial part of the subcutaneous tissue down the front of the thigh or in the ischiorectal fossa.

The concept of one layer of collagenous and elastic fibers around deposits of fat and not two distinct layers (an outer fatty and an inner membranous) in the subcutaneous tissue has been recognized for many years. Langer (1861) Kocher (1907) and Cox (1941) suggested a similar structure for the subcutaneous tissue and showed that the cleavage lines of the skin are related to the direction of the fibers in this tissue as well as their connection to the deep fascia or periosteum in certain areas.

There appears to be no justification for the concept of an outer fatty (Camper's) and an inner membranous (Scarpa's-Colles') fascia in the subcutaneous tissue from historical priority of definition anatomic structure, or the involvement of this tissue in real or simulated cases of urinary extravasation. This erroneous concept was introduced into the medical literature through sources as yet unidentified and has been perpetuated by tradition and inadequate means of study. The authors (Tobin and Benjamin 1944 and 1946) also conformed to the usual concept of the form and attachments of these layers when dissection was used as a means of approaching such problems.

#### SUMMARY

The present concept of an outer fatty (Camper's) and an inner membranous (Scarpa's-Colles') fascia in the subcutaneous tissue over the ventral abdominal wall and in the perineum and their role in directing and limiting the spread of extravasates are not justified for the following reasons:

1. There are many inconsistencies in the anatomic texts as to the structure and continu-

ity of these layers and their relation to the cutaneous nerves and vessels which may be due to the fact that no priority of definition could be found for these fasciae since Camper Scarpa and Colles did not describe these layers as they are currently defined.

2 Studies from microscopic and macroscopic sections from these regions show that the subcutaneous tissue is made up of only one layer—strands or sheets of collagenous and elastic fibers surrounding deposits of fat which is similar to the structure of this tissue in other areas of the body

3 Sections taken from and dissections made of real and simulated cases of extravasation from the penile urethra demonstrate that the extravasates are within the one common layer and not limited by a deep membranous (Scarpa's-Colles') layer. The attachment of the collagenous and elastic fibers to the deep fascia or periosteum of the body wall as well as the change in direction of these fibers and the compactness or looseness of the one subcutaneous layer account for the direction and limitation of the spread of extravasates

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## GASTRIC RESECTION FOR ESOPHAGITIS AND STRICTURE OF ACID-PEPTIC ORIGIN

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IN September 1939 a patient was operated upon by one of us, (O.H.W.) at the University of Minnesota Hospitals, for massive hemorrhage from a duodenal ulcer. The patient had no antecedent story of esophagitis for which one of us (N.L.L.) had supervised frequent esophageal dilatations over a period of approximately 4 years. An unexpected windfall from this operation was that dilatation of the esophageal stricture became unnecessary following the procedure of gastric resection for the duodenal ulcer. In the course of the operative procedure undertaken to control the gastric hemorrhage simultaneous extensive gastric resection was performed to thwart further ulcer difficulty. Three years later the same sequence of events was observed in another patient undergoing gastric resection for a gastrojejunal ulcer (following gastrojejunostomy performed for an obstructive duodenal ulcer) this patient also had esophagitis necessitating esophageal dilatation. On the basis of the cessation of necessity for continued esophageal dilatation in the first patient whose esophageal stricture had been dilated more than 100 times one of us (O.H.W.) ventured to predict that successful relief of the ulcer diathesis in this instance too might make further esophageal dilatation unnecessary. Such proved to be the case.

When therefore a third patient presented herself with a picture of a congenitally short esophagus, an esophageal stricture and gastric hemorrhage of unknown etiology it was reasoned that the stricture in this instance too might be occasioned by the regurgitation of hydrochloric acid into the lower reaches of the

esophagus. This latter patient was referred for resection of the esophageal stricture. She was in very poor physical condition presenting all the clinical evidences of hypoproteinemias from starvation. The patient was easily persuaded, in the light of the success in the other 2 patients to accept the suggestion that an extensive gastric resection be done with the thesis in mind of reducing the capacity of the residual gastric pouch to provide an active acid peptic digestive juice the regurgitation of which into the esophagus, in all likelihood, had been causing the patient's symptoms. A dramatic improvement followed the gastric resection and helped confirm in our minds the impression that esophagitis and esophageal stricture might well be a consequence of the acid peptic digestive mixture in the same manner that duodenal ulcer is. Thereafter 2 additional patients with strictures fairly high in the esophagus were persuaded to accept the same operative procedure with hope of relief from esophageal obstruction. Operation in these latter patients has been done quite recently yet the improvement has been so startling as to warrant, despite this somewhat meager experience, the placement of these case histories on record. In the main, they give fairly satisfactory proof that esophagitis is probably a manifestation of ulcer just as much as is an ulcer in the stomach or in the duodenum. Four of the patients listed herein probably had what is ordinarily called esophagitis. Three of the 4 had duodenal ulcer (Cases 1, 2 and 6) and rather severe concomitant complications from the duodenal ulcer the fourth patient had esophagitis only. One of the remaining 2 patients had a congenitally short esophagus with a stricture. She too however had gastric hemorrhage. In this latter instance prior to operation the interpretation put upon the sequence of events was that she 'probably had portal hypertension, a

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Fig 1 Case 1. a, left, Esophagram showing extent of esophageal stricture, April 1, 1936, there is considerable dilatation of the esophagus above the stricture. b, Normal esophagram, April 3, 1948, almost 9 years after gastric resection, September 2, 1939 for bleeding duodenal ulcer. The patient is symptomatically well and has no demonstrable esophageal narrowing; moreover there is no dilatation of the esophagus above the site of the former stricture.

ruptured esophageal varix which healed with stricture formation—all of which suggested to the medical service that local excision of the esophageal stricture was perhaps the best therapy. The remaining patient in the group was a young boy who since early years had had trouble in swallowing; the difficulty in swallowing became progressive eventually necessitating frequent dilatation. The case histories of these patients follow.

#### CASE HISTORIES

**CASE 1.** Mr L. W. was admitted to the University Hospital on September 3, 1939 and dismissed on September 22, 1939. Patient was 53 years of age at the time of that admission (U. H. No. 643715).

Twenty years ago the patient had had a diagnosis of duodenal ulcer; however it did not give him much trouble until 1935, since which time he has had considerable trouble with periodic obstruction as well as bleeding. The patient was first admitted to the University Hospital in November 1935, with a diagnosis of duodenal ulcer with obstruction; he was hospitalized by the medical service for approximately 1 month and was placed on a Sippy regimen. Following dismissal he began reporting to the out-patient clinic of the department of medicine in January 1936. In February 1936 he complained of difficulty in swallowing and when an esophagram was made a stricture was described in the lower third of the esophagus. On esophagoscopy it was found to be 38

centimeters from the incisor teeth. The stricture was rather long and smooth. In April 1936 dilations were begun and once or twice each month the esophagus was dilated up until the time of surgery, which was done in September, 1939. In the interval between dilations the esophageal stricture would usually shrink down to a No. 37 French but could be dilated again without too much difficulty up to a No. 45 French. In February 1936 the patient was hospitalized again for the treatment of his ulcer for a period of about a month. He was discharged with the diagnosis of obstructive duodenal ulcer and esophageal spasm and stricture (Fig. 1 a). In September 1936 he was hospitalized for a period of 3 weeks under medical management with the same diagnosis. In March 1938 he was hospitalized again for a period of 2 weeks.

In August, 1939 the patient was admitted to the medical service for treatment of a bleeding duodenal ulcer. While under medical management the bleeding continued and on September 2, 1939 the hemorrhage was profuse. The hemoglobin, despite transfusions, had fallen from 100 per cent following transfusions down to a level of 20 per cent. Because of this operation was undertaken as an emergency measure—a two-thirds gastric resection being done with open closure of the duodenum. Considerable blood was found in the intestine at the time of the operation. Prior to operation the patient had 38 degrees free hydrochloric acid in a fasting specimen without histamine. Convalescence was satisfactory and patient was dismissed from the hospital 20 days after operation. Several transfusions were given just prior during and after operation.

1 November the esophagus was dilated and it was found that it had only contracted down to N. 41 French and dilatation with a No. 45 French bougie was easy. A similar dilatation was done in December and the figures were the same. In February 1940 it was found on examination that a No. 43 French catheter passed easily. The esophagus was dilated up to a No. 45. This was repeated in April and again in June and when the bougie was passed in August, 1940, it was found that a No. 45 went down readily. The patient came in again for examination in March 1941 at which time a No. 45 French sound passed easily. 1 January 1945 4 years later the patient came in for observation at which time he said he had had no further difficulty in swallowing and was not in need of further esophageal dilatation. It was seen here recently (April 1948) there was no difficulty swallowing an esophagram showed a fairly normal esophagus and a No. 45 French bougie passed without difficulty (Fig. 1 a and b).

**Summary** A patient of 53 had been hospitalized many times because of the complications of duodenal ulcer. Prior to September 1939 when an emergency gastric resection was done for massive hemorrhage from a duodenal ulcer the patient's esophagus had been dilated approximately 100 times because of esophagitis and stricture. Whereas it had been anticipated that the need for esophageal dilatation would continue it was observed that further esophageal dilatations were unnecessary (Fig. 1 a and b).

**CASE 2** M. C. V. D. was aged 85 at the time of admission to University Hospital (U. H. N. 620411).

This patient was first seen at the University Hospital for prostatic obstruction in 1933 at which time he was 75 years of age. In July 1934 he returned because of a very large right anterior suprahepatic abscess the patient at this time was very ill. Aspiration with needle was carried out below the right costal margin, the abscess being large and anterior. Subsequently an empyema trochar was inserted and catheter was threaded into the abscess cavity. The patient had a duodenal fistula which closed only slowly. When subsequently during his convalescence barium was given the barium found its way through the duodenal ulcer perforation into a large subphrenic space on the right side.

In 1938 the patient returned because of a bleeding ulcer. He was given several x-ray examinations during 1935 and 1936 and a definite duodenal deformity was observed. In 1936 he was hospitalized by the medical service because of hemorrhage and pain. In 1938 he was hospitalized again because of hemorrhage and at the same time he was treated on the eye service for a conjunctivitis of the left eye. Because of repeated and recurrent attacks of pyloric obstruction the patient was hospitalized in Decem-

ber 1941 and gastrojejunostomy, together with an enteronastomosis was made. The patient was 83 years of age and it was believed that because of his age gastrojejunostomy was an adequate operation. He improved considerably after the gastrojejunostomy but in January 1942 he complained of a good deal of trouble in swallowing. Because of his generally poor condition he was readmitted for dilatation of the esophagus. Already in December 1941 at which time the patient was admitted for gastrojejunostomy narrowing of the lower end of the esophagus was noted on x-ray examination though at this time the patient did not complain of much difficulty in swallowing. The patient continued to come to the out-patient clinic for periodic dilatation of the esophageal stricture involving the distal 4 centimeters of the esophagus. The patient at this time was subjected to dilatation at 3 week intervals. In August 1942 it was suggested by one of us (O. H. W.) that gastric resection might help the esophageal stricture on the basis that it had helped the esophageal stricture in the instance of Case 1. Mr. L. W. who had undergone gastric resection 3 years previously for massive hemorrhage from a bleeding duodenal ulcer. Because of roentgen-ray evidence suggesting the presence of a jejunal ulcer as well as continued pyloric obstruction gastric resection was undertaken. Because of the difficulty of mobilizing the deformed duodenum, a Finsterer exclusion type of operation called the "IVA" operation in this clinic was done. The weight of the fragment of stomach removed was 385 grams obviously there was a good deal of pyloric obstruction to produce a stomach of this size. By this time too the technique of gastric resection for ulcer had been well standardized in this clinic, and the conventional short loop posterior anastomosis with a 75 per cent resection was done. The enteronastomosis was taken down and an end-to-end anastomosis in the jejunum was made there.

Following the gastric resection the patient continued to improve quite definitely. Occasional esophageal dilatation was carried out but it soon became apparent that further dilatation was probably not necessary. On each occasion when dilatation was carried out after June 1943 No. 45 dilator passed through easily. When the patient was last seen in this clinic in February 1945, it was obvious that further esophageal dilatation was unnecessary. A recent letter (May 1948) from the patient physician, Dr. M. D. Mosby of Long Prairie, Minnesota states that the patient had no further difficulty in swallowing after the gastric resection and that the patient died of senility and uremia on July 3, 1947 at 90 years of age.

**Summary** A patient of 85 years since the age of 75 had been incapacitated because of frequent recurrence of complications of a duodenal ulcer. Gastrojejunostomy carried out for an obstructive duodenal ulcer was followed by a gastrojejunal ulcer accompanied by pro-

gressive symptoms of esophageal stricture. Complete relief of the ulcer diathesis followed gastric resection and esophageal dilatation became unnecessary. The patient died 5 years later of senility at the age of 90 years. He had experienced no difficulty in swallowing after gastric resection.

**CASE 3.** Mrs. E. K., 58 years of age at the time of admission to the University Hospital (U. H. No. 672670).

This patient has been coming to the University Hospital intermittently since October 1938. She then gave a story of dysphagia of 3 months duration. In January 1936 the patient had a massive hematemesis followed by melena. An abdominal exploration was done elsewhere shortly after an episode of hematemesis at which time a large mass was found in the upper abdomen and a diagnosis of cystic disease of the liver and pancreas was established. Subsequent to the operation two subsequent episodes of hematemesis were experienced by the patient. Large abdominal masses were observed here on physical examination; moreover the patient was found to be anemic, the hemoglobin being only 63 per cent. The white blood cell count was normal with a normal differential. Red blood cells were 2,890,000. Plasma proteins, blood cholesterol and nonprotein blood nitrogen values were normal when the patient was first seen here. Liver function tests were within normal limits.

X-ray examinations demonstrated a stricture in the lower 10 centimeters of the esophagus. The suggestion of a congenitally short esophagus was made. Esophagoscopy revealed a stricture 31 centimeters from the incisor teeth. In the x-ray film the stricture appeared to cover a distance of 3 to 4 centimeters. A pebble like appearance caused by the inflammation of the dilated portion of the esophagus was reported.

Because of the stricture dilatations were instituted beginning with a No. 31 French bougie. The first dilatations were carried up to a No. 39 French. The patient was dismissed from the medical service with a diagnosis of esophageal stricture, probably on the basis of a ruptured esophageal varix with secondary scarification of the esophagus.

Over a period of the next few years the patient was admitted frequently to the medical service of the University Hospital here for dysphagia, hematemesis or other circumstances requiring hospitalization. On one hospital admission a cystocele was repaired; the patient intermittently had swelling of the ankles; there was some hypertension with electrocardiographic evidence of myocardial damage, probably the result of an earlier myocardial infarction. The blood pressure varied between 150 and 185 systolic, with diastolic recordings in the area of 90 to 100. Passive congestion of the lungs and liver was diagnosed. The patient also had emphysema. The plasma proteins were quite consistently under 6 grams

per cent and on one occasion the plasma proteins were as low as 5 grams per cent.

Gastric analysis was made on several occasions and free acid without histamine was 28 degrees with a total acid of 54 degrees; on another occasion with histamine the free acid was 34 degrees with a total of 50 degrees. However the recovery in quantity of acid from the stomach was usually large on each occasion. The patient had occult blood in the stool quite consistently and the hemoglobin varied between 7 and 11 grams.

Despite monthly dilatation the patient's nutrition seemed to worsen, and because of the difficulty in swallowing and the fairly persistent anemia and repeated episodes of bleeding the patient was referred for excision of the stricture in the esophagus in April 1944 (Fig. 1 a). The patient lived in the northern section of the state, almost 400 miles from Minneapolis and had been contemplating moving her home to this area to lessen the difficulty of travel made necessary by the frequent dilatations. The stricture began apparently in the upper portion of the lower third of the esophagus and because of the patient's poor condition operation at that time was not recommended. However the patient was advised that the patient in Case 1 reported here too had undergone approximately 100 esophageal dilatations but that complete freedom from the symptoms of dysphagia had been obtained following gastric resection carried out because of massive hemorrhage from a duodenal ulcer. On August 9, 1944, Mrs. E. K. was admitted for gastric resection; she thought being that regurgitation of acid into the lower reaches of the esophagus was the likely cause of the stricture. This operation was carried out on August 14, 1944.

At operation it was found that the patient had a congenitally short esophagus with a small para-esophageal hernia. She had been under the observation of Dr. N. Logan Leven for some time for esophageal stricture. The question arose as to what to do for this patient. At one juncture, Dr. Leven favored resection of the esophagus with end-to-end anastomosis; moreover the stricture was fairly high up in the esophagus. An alternative procedure would have been to have made a lateral anastomosis between the esophagus and the cardiac end of the stomach through the diaphragm from above. A third procedure which appealed to me (O. H. W.) as being perhaps most rational was to do a gastric resection as one does a gastric resection for duodenal ulcer, since it is our opinion that the esophagitis and stricture are consequent to regurgitation of free hydrochloric acid into the lower reaches of the esophagus. It had been difficult to obtain samples of free acid because of the difficulty of passing an ordinary duodenal tube through the stricture. The patient did have free acid however on a lasting sample as well as after the use of histamine. The quantity of acid aspirated from the stomach was large though the acidities were not unusual.

The field of operation was prepared with Novak's solution. Cyclopropane anesthesia was found to be

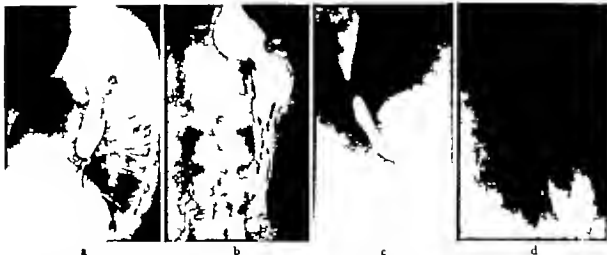


Fig. 2. Case 3. a, Cork-screw stricture of lower third of esophagus. Considerable dilatation. Ith food retention above the stricture. A portion of the stomach appears to be above the diaphragm. Situation in April, 1944, few months prior to operation. b, The status of the lower esophagus and residual gastric pouch 7 years after operation.

tion, August 4, 1944. c, Esophagram almost 4 years after gastric resection, May 5, 1948. There is no residual evidence of the former strictures and the cork-screw like deformity of the esophagus has disappeared. d, Normal esophagram same for persistent appearance of gastric mucosa-like folds in lower esophagus, May 5, 1948.

satisfactory. A left subcostal incision was used. At operation a fairly large cystic liver was found, the left lobe being as large as a normal sized right lobe. There were several large cysts, some of which held more than 3 ounces of fluid. Many adenomas were noted in the liver. A few small cysts were felt along the left kidney and there were many cysts in the pancreas. The right kidney seemed small and it was not certain whether or not it contained any cysts. Adhesions were noted from the omentum down to the left lower quadrant. Many diverticula were felt in the descending and pelvic colon. After discussing our findings with Dr. N. Leven and with the patient both agreed that perhaps gastric resection was the best procedure. It was impossible to pass a duodenal tube through the stricture into the stomach prior to operation. Fluoroscopic examination revealed that the duodenal tube was in the esophagus.

The first step in the operation was to make a gastrostomy opening through which a catheter was passed up through the esophageal stricture. Passage of the catheter was rather difficult; a small No. 33 bougie was finally pushed through. The catheter was caught above and sutured in place and a duodenal tube was pulled down. Then we used a larger bougie. Finally a fairly large bougie went through the stricture. The duodenal tube was left in the stomach, the gastrostomy opening was closed and the resection was carried out. A group III 75 per cent resection was done together with excision of the pylorus and antrum. A Hofmeister retrocolic type of gastrojejunostomy anastomosis was done with two rows of sutures, the anastomosis being made at the ligament of Treitz. The duodenum was closed with two rows of fine interrupted silk sutures over Potts

clips. The catheter in the stomach was pushed into the proximal duodenojejunal loop. The adhesions to the left lower quadrant were all divided. There was also an area in the small intestine, perhaps in the midileum, where the gut was badly kinked by adhesions. These were cut and the bowel was made free. A tear in the surface of the bowel necessitated resuturing with fine interrupted silk. Interrupted silk sutures were used for closure of the abdominal wall. The patient took this rather long operative ordeal quite satisfactorily and left the operating table in good condition. Despite this fact convalescence was rather slow and the patient stayed in the hospital until the first of September, at which time she was discharged. On September 1 she appeared in the out-patient clinic and said that she could walk without difficulty and was eating bread and meat. At this time she returned to her home in International Falls and was not seen in the out-patient clinic again until December 13, 1944. At this time a No. 43 French bougie went down without difficulty. The plasma proteins on December 24, 1944, were 7.1 grams per cent. She appeared to be improving continuously despite the circumstance that her appetite was none too good. On February 21, 1945, a dilator was again passed and it was found that a No. 45 French bougie went down readily. After this there appeared to be no further need for dilations. In February 1946 a sound was passed and was found to go down without difficulty. In August 1946 the patient was hospitalized for a cold and because of asthmatic bronchitis. The presence of arteriosclerotic heart disease and polycystic liver and pancreas was again reaffirmed on physical examination.



Fig 3 Case 4. a, Extent of esophageal stricture November 27, 1946, patient could swallow only fluids. b, Esophagram, March 2, 1948, 8 months after gastric resection (June 27, 1947) shows disappearance of stricture and a normal esophagus. The patient can eat anything. c, Esophagram, May 18, 1948.

There has been no recurrence of hematemesis and no difficulty in swallowing since the time of the operation in August 1944. The patient's hemoglobin has continued between 12.5 to 13 grams per cent since operation. She eats everything and seems to be getting on quite satisfactorily and has gained considerable weight. An x-ray examination of the esophagus made in September 1944, a month after the operation, showed some narrowing of the distal third of the esophagus. An x-ray examination made 2 years later indicated that the esophagus was normal. Both proximal and distal loops of the gastrojejunal stoma fill readily. The present condition of the esophagus is shown in Figure 2 b, c, and d.

**Summary** This patient had polycystic disease of the liver and pancreas, a congenitally short esophagus and an esophageal stricture of unknown origin. There had been several episodes of hematemesis and it had been reasoned that bleeding was caused by esophageal varices followed by scar formation and esophageal stricture. Esophageal dilatation had been done approximately 100 times over a 6 year interval. Her nutrition was poor and edema and hypoproteinemia were present. Resection of the esophageal stricture had been urged but gastric resection was carried out on the thesis that the esophageal stricture was probably a manifestation of ulcer disease. The result justified the means (Fig 2 a, b, c, and d).

**CASE 4** Mr C G, aged 17 years, first came here in November 1946 with a story of difficulty in swallowing (U. H. No. 772864).

The difficulty in swallowing dated back over many years but had been getting worse and worse until the patient could no longer swallow solid foods of any kind. The hemoglobin was 16 grams per cent, the free hydrochloric acid fasting was 18 degrees with 60 degrees of free hydrochloric acid after histamine. The volume of secretion was large, being 100 cubic centimeters fasting and 88, 70 and 50 cubic centimeters respectively after three successive doses of 0.5 milligram of histamine given at 30 minute intervals. Considerable difficulty was had in dilating the patient's esophageal stricture. A No. 37 French dilator causing a good deal of bleeding. An esophagram disclosed stricture of the distal third of the esophagus with considerable narrowing and some dilatation of the proximal two-thirds of the esophagus (Fig 3 a).

Esophagoscopy was done on November 20 and disclosed stricture of the lower end of the esophagus. Biopsy specimen was taken and the histologic diagnosis was chronic inflammation. The biopsy tissue was taken 20 centimeters from the teeth. Another fragment of tissue was taken at 32 centimeters from the teeth. All these areas showed evidence of chronic inflammation (esophagitis).

Following dilatation the patient's condition improved and he continued to return for further dilatation at 2 week intervals. On June 27, 1947, because of the continued necessity of dilatation, a gastric resection was done (75 per cent). Inasmuch as an attempt was being made here to evaluate com-





Fig. 3. Case 3. Cork-screw stricture of lower third of esophagus. Considerable dilatation with food retention above the stricture. A portion of the stomach appears to lie above the diaphragm. Situation in April, 1944, few months prior to operation. b, The status of the lower esophagus and residual gastric pouch 4 years after operation.

tion August 4, 1944. c, Esophagogram almost 4 years after gastric resection. May 5, 1945 there is no residual evidence of the former stricture and the cork-screw like deformity of the esophagus has disappeared. d, Normal esophagogram seen for persistent appearance of gastric mucosa-like folds in lower esophagus, May 5, 1945.

satisfactory. A left subcostal incision was used. At operation a fairly large cystic liver was found, the left lobe being as large as a normal sized right lobe. There were several large cysts, some of which held more than 3 ounces of fluid. Many adenomas were noted in the liver. A few small cysts were felt along the left kidney and there were many cysts in the pancreas. The right kidney seemed small and it was not certain whether or not it contained any cysts. Adhesions were freed from the omentum down to the left lower quadrant. Many diverticula were felt in the descending and pelvic colon. After discussing our findings with Dr. N. Leven and with the patient both agreed that perhaps gastric resection was the best procedure. It was impossible to pass a duodenal tube through the stricture into the stomach prior to operation. Fluoroscopic examination revealed that the duodenal tube was in the esophagus.

The first step in the operation was to make a gastrostomy opening, through which a catheter was passed up through the esophageal stricture. Passing of the catheter was rather difficult; a small No. 45 French bougie was finally pushed through. The catheter was caught above and sutured in place and a duodenal tube was pulled down. Then we used a larger bougie. Finally a fairly large bougie went through the stricture. The duodenal tube was left in the stomach, the gastrostomy opening was closed, and the resection was carried out. A group III 75 per cent resection was done together with excision of the pylorus and antrum. A Hofmeister retrocolic type of gastrojejunal anastomosis was done with two rows of sutures, the anastomosis being made at the ligament of Treitz. The duodenum was closed with 2 rows of fine interrupted silk sutures over Peta

clips. The catheter in the stomach was pushed into the proximal duodenojejunal loop. The adhesions to the left lower quadrant were all divided. There was also an area in the small intestine, perhaps in the middleum where the gut was badly kinked by adhesions. These were cut and the bowel was made free. A tear in the surface of the bowel necessitated resuturing with fine interrupted silk. Interrupted silk sutures were used for closure of the abdominal wall. The patient stood this rather long operative ordeal quite satisfactorily and left the operating table in good condition. Despite this first convalescence was rather slow and the patient stayed in the hospital until the first of September at which time she was discharged. On September 1, 1944 she appeared in the out-patient clinic and said that she could swallow without difficulty and was eating bread and meat. At this time she returned to her home in International Falls and was not seen in the out-patient clinic again until December 13, 1944. At this time a No. 45 French bougie went down without difficulty. The plasma proteins on December 24, 1944, were 7.1 grams per cent. She appeared to be improving continuously despite the circumstance that her appetite was none too good. On February 21, 1945 a dilator was again passed and it was found that a No. 45 French bougie went down readily. After this there appeared to be no further need for dilations. In February 1946 a sound was passed and was found to go down without difficulty. In August 1946 the patient was hospitalized for a cold and because of asthmatic bronchitis. The presence of arteriosclerotic heart disease and polycystic liver and pancreas was again reaffirmed on physical examination.



Fig 3 Case 4. a Extent of esophageal stricture November 27, 1946 patient could swallow only fluids b Esophagram, March 2, 1948, 8 months after gastric resection (June 27, 1947) shows disappearance of stricture and a normal esophagus The patient can eat anything c, Esophagram, May 18, 1948.

There has been no recurrence of hematemesis and no difficulty in swallowing since the time of the operation in August 1944. The patient's hemoglobin has continued between 12.5 to 13 grams per cent since operation. She eats everything and seems to be getting on quite satisfactorily and has gained considerable weight. An x ray examination of the esophagus made in September 1944 a month after the operation showed some narrowing of the distal third of the esophagus. An x ray examination made 2 years later indicated that the esophagus was normal. Both proximal and distal loops of the gastrojejunal stoma fill readily. The present condition of the esophagus is shown in Figure 2 b c, and d.

**Summary** This patient had polycystic disease of the liver and pancreas a congenitally short esophagus and an esophageal stricture of unknown origin. There had been several episodes of hematemesis and it had been reasoned that bleeding was caused by esophageal varices followed by scar formation and esophageal stricture. Esophageal dilatation had been done approximately 100 times over a 6 year interval. Her nutrition was poor and edema and hypoproteinemia were present. Resection of the esophageal stricture had been urged but gastric resection was carried out on the thesis that the esophageal stricture was probably a manifestation of ulcer disease. The result justified the means (Fig 2 a b c, and d).

**CASE 4.** Mr C G. aged 17 years first came here in November 1946 with a story of difficulty in swallowing (U. H. No. 772864).

The difficulty in swallowing dated back over many years but had been getting worse and worse until the patient could no longer swallow solid foods of any kind. The hemoglobin was 16 grams per cent the free hydrochloric acid fasting was 18 degrees with 60 degrees of free hydrochloric acid after histamine. The volume of secretion was large being 100 cubic centimeters fasting and 88, 70 and 50 cubic centimeters respectively after three successive doses of 0.5 milligram of histamine given at 30 minute intervals. Considerable difficulty was had in dilating the patient's esophageal stricture a No. 37 French dilator causing a good deal of bleeding. An esophagram disclosed stricture of the distal third of the esophagus with considerable narrowing and some dilatation of the proximal two-thirds of the esophagus (Fig 3 a).

Esophagoscopy was done on November 20 and disclosed stricture of the lower end of the esophagus biopsy specimen was taken and the histologic diagnosis was chronic inflammation. The biopsy tissue was taken 29 centimeters from the teeth. Another fragment of tissue was taken at 32 centimeters from the teeth. All these areas showed evidence of chronic inflammation (esophagitis).

Following dilatation the patient's condition improved and he continued to return for further dilatation at 2 week intervals. On June 27, 1947 because of the continued necessity of dilatation a gastric resection was done (75 per cent). Inasmuch as an attempt was being made here to evaluate com-

plete extrinsic deviation of the stomach a vagotomy and bilateral celiac ganglionectomy were carried out simultaneously. Convalescence was satisfactory and patient was discharged from the hospital on July 3. On July 5 he returned with the picture of a psychosis and was hospitalized for a period of 13 days by the psychiatric service.

There has been considerable and continued improvement since the gastric resection in the patient's ability to swallow; moreover when he has returned to dilatation the tendency of the stricture to narrow down and resist stretch has not been observed previously. In February 1948 a 45 French bougie went through without difficulty and there seemed to be minimal evidence of any constriction. At the present time (May 1948) the patient can eat solid foods such as bread and meat without difficulty. Moreover the esophageal shadow shows considerable improvement from the preoperative situation (Fig. 3, 1 and c). The boy appears to have made a very satisfactory functional adjustment too and is getting on very well in school.

**Summary.** A boy of 17 years with a stricture of the lower half of the esophagus of unknown origin. Esophagoscopy indicated the presence of esophagitis. No ulcer could be demonstrated but the gastric acids were high. During the year prior to operation esophageal dilatation was done usually every 2 weeks to help maintain a flagging nutritional status. Gastric resection was followed by complete relief of the difficulty in swallowing (Fig. 3, a and b).

**CASE 5.** Mrs. A. C. aged 56 years (U. H. N. 66758).

Patient began coming to the City Hospital in 1938 because of painful running ears. She was then 46 years of age. Tonsillectomy was done and on later admissions mastoid operations were performed. In 1939 the patient underwent panhysterectomy in the gynecological department of the hospital for a teratoma of the ovary. In 1942 it was noted that the patient had trouble in swallowing solid food. When esophagium was made in July 1942 esophageal strictures together with a peribulbar ulcer were reported. These findings were confirmed by re-examination of the esophagus in June 1943. Gastric analysis in July 1943 showed a large volume of gastric secretion with 66 degrees of free hydrochloric acid and a histamine. Frequently during 1943 and 1944 when the stool was studied for occult blood (guaiac) blood was almost always found. The stool at this time was found to be occult blood. At this time diagnosis of likely esophageal stricture had been made.

In July 1944 on the basis of the symptoms the patient was put on a Sippy diet. The powder because of the complaint of gastric pain and difficulty in swallowing food seemed to tickle the esophagus and there was dull pain behind the sternum

on swallowing. The patient meanwhile was observed in the psychiatric clinic and was treated for emotional lability. In August 1943 the patient was confined on the basis of her own symptoms that she had a peptic ulcer. The patient continued to be observed in the psychiatric clinic but by July 1944 the physicians in the department of internal medicine in the out-patient clinic were convinced that the patient had an ulcer together with esophageal stricture and esophageal varices.

Admission of esophageal stricture and esophageal varices was established by esophagoscopy examination in September 1947. The patient continued to complain of postprandial pain on eating and persistent difficulty in swallowing. She can swallow only soft food and meat and vegetables such as celery and carrots cannot be swallowed. A gastric analysis done with histamine on February 3, 1948 demonstrated large quantities of acid in each specimen. The highest amount of free hydrochloric acid was 100 degrees following the second half milligram of histamine. The patient had had no dilatation of her esophagus prior to operation but there was a history of difficulty in swallowing for approximately 6 years.

On March 25, 1948 a conventional 80 per cent gastric resection (Group III) operation was done on the basis that the patient had digestive difficulties were probably eventually manifestation of ulcer disease that would go to the hyperchlorhydria he probably had periodic erosions or ulcers in the stomach as well as a persistent esophagitis. The portal anastomosis was measured at the time of operation and was found to be only 8 centimeters of saline solution. It is unlikely therefore that the patient has portal hypertension or so-called esophageal varices. The spleen was found to be small but because of the confirmed presence of esophageal varices and portal hypertension prior to operation, it was thought wise to excise the spleen and to perform a biopsy upon the liver. The liver itself looked normal and proved to be so histologically. Convalescence was satisfactory and was followed by temporary diarrhea, patient got on very well. Almost from the beginning following the operation, he swallowed considerably better. When an esophagram was made on May 4 the stream of barium went down more readily than on previous examinations.

**Summary.** A patient with unusual complaints who had diagnosed her own condition 5 years previously as being due to ulcer. Dysphagia also had been present over a 5 year interval. A recent gastric resection was done with relief of abdominal pain and difficulty in swallowing.

**CASE 6.** Mr. H. B. aged 47 years (U. H. N. 780565).

This patient had a history of peptic ulcer since 1911. In 1930 he had duodenal ulcer perforation which was closed surgically. Six weeks later the



Fig. 4. Case 6. a. When this film was made, June 4, 1947 the patient had carried a gastrostomy for several years, he could not swallow his saliva. The duodenum is deformed and there is a crater in the pyloric outlet. b. Nature and extent of stricture, March 3, 1948. A satisfactory esophagram was not obtained after esophageal dilatation. c. Esophagram made May 18, 1948. 5 months after gastric resection on March 19, 1948 the esophagram has improved as has the patient. The patient is eating solid food and is swallowing satisfactorily. The esophagus will have to be dilated periodically until it will take a No. 45 French dilator. It remains to be seen whether a normal appearing esophagus can be re-established in this patient.

obstruction of the esophagus had progressed to the extent that he could not swallow his saliva and a gastrostomy was done to permit feeding him. This was done at the Wisconsin General Hospital. Since performance of his gastrostomy he has been able to swallow liquids only periodically usually having to expectorate saliva as well. In the summer of 1947 his physician Dr. William Focke of Poynette Wisconsin was in the clinic when the preceding case that of C. G. was being discussed in the out patient clinic. He had just returned a few weeks after gastric resection and reported himself as already improved. Dr. Focke said he had a patient who in many respects was very much like the case of C. G. and volunteered that he would like to send his patient here. The patient arrived in July 1947 and an effort was made to examine the esophagus with barium but so little barium went through that the examination was unsatisfactory (Fig. 4 a). An attempt was made to use the esophagoscope and this also was unsatisfactory. Finally a No. 5 ureteral catheter was passed down the esophagus into the stomach and was fished out through the gastrostomy opening. A silk thread was then brought back and anchored to the cheek. After dilatation re-examination was done with barium and it was found that a stricture extended down from the midsegment of the thoracic esophagus to the stomach (Fig. 4 b). With many dilatations it became possible to dilate the esophagus up to about a No. 20 French. At that juncture the

patient felt much better so he left and was not seen for several months.

Meanwhile January 1948 another perforation of a duodenal ulcer occurred. This time the patient was treated conservatively by suction applied to the gastrostomy tube and he appeared to get on satisfactorily. When he reported here for observation again in April 1948 the esophagus again appeared completely occluded. The esophagus was gradually stretched up to a No. 20 French again. The patient's hemoglobin at this time was 14.3 grams, leucocytes numbered 10,500. There was a large volume of acid in every sample aspirated. Volumes of 45 to 50 cubic centimeters were present in each specimen including the fasting specimen. The free hydrochloric acid fasting was 45 degrees and after histamine rose to 74 degrees. When the patient came here he was thin, very weak and it was difficult for him to stand.

At the time of operation on March 19, a granuloma containing purulent material was found in the retro-gastric space suggesting that the perforation in January had occurred into the lesser sac. There was a hard thick fibrous plastic area plastered up against the transverse colon which lent the impression in the preoperative x ray film of a stricture there. The stomach was large. It became necessary to make an open closure of the duodenum. This was made with a single row of interrupted silk sutures. The duodenojejunal ligament was dissected down with some difficulty and 80 per cent of the stomach was re-

sected. The removed gastric segment devoid of omentum, weighed 227 grams. A single row gastrojejunal anastomosis was made and the lying duodenal tube was placed in the proximal duodenojejunal loop. Because of the presence of the subclinical retrogastric abscess encountered (absence of fever and leucocytosis) air vent suction drains were put into the subhepatic area on the right and behind the spleen on the left side. The patient convalesced satisfactorily but was kept in the hospital for weeks after operation to encourage better feeding. About the time the patient left the hospital it was found that a No. 20 French bougie was inserted without any difficulty. Two weeks later he returned and dilatation was accomplished up to a No. 33 French without any difficulty. A few days later it was found that a No. 35 French bougie could be passed without much difficulty. At this juncture the patient returned home. He returned for observation again May 5, approximately 6 weeks after the operation, and said that he was eating well and had no difficulty in swallowing. At this time the esophagus was dilated to a No. 37 French with little difficulty. May 8th patient returned at our request and it was found that a No. 37 French bougie went through without great difficulty. The patient is having very little difficulty in swallowing. Moreover the x ray film made at this time showed considerable improvement in the lower reaches of the stricture but still showed some evidence of spasm or narrowing at the upper end of the esophageal stricture (Fig. 4, c). The patient is eating well however and feels considerably improved. He eats meat, hard rolls, celery and carrots without difficulty. Prior to the operation, it is to be remembered the patient had difficulty in swallowing his saliva.

**Summary** A patient of 47 years with a history of periodic severe difficulty from a duodenal ulcer since the age of 10. Eight years prior to admission here surgical closure of a duodenal perforation was done followed a few months later by gastrostomy for feeding because of the patient's inability to swallow his own saliva occasioned by the stricture of the lower half of the esophagus. Considerable improvement following a recent gastric resection (Fig. 4, a, b and c).

#### ETIOLOGICAL CONSIDERATIONS

Whereas this group of cases is small and in the instance of the last 2 patients cited, the

In the patient dilatation is still being done at gradually lengthening intervals. He eats everything and gets on very well. Some of the other patients reported herein require dilatation. One additional patient, M. B. N. aged 70, University Hospital No. 74466, with esophageal stricture accompanying dilatation has been subjected to gastric resection since this paper was written. If moderate dilatation on July 14, 1935, his subsequent pain is gone and security for continued dilatation has disappeared.

time interval has been brief nevertheless, it is difficult to escape the conclusion that esophagitis is a manifestation of ulcer disease.

Much has been written about the etiology of esophagitis. Vinson (1940) suggests that nonspecific inflammation is the most common lesion of the esophagus and that the majority of benign strictures are of uncertain etiology. Vinson states that approximately 10 per cent of esophageal strictures occur as a sequel to the nausea and vomiting of pregnancy. Butt and Vinson (1936) observed that postmortem evidences of esophagitis occur in 7 per cent of individuals. Twenty per cent of that number had a history of peptic ulcer. Olsen (1948) stresses the association of abdominal disease especially illness giving rise to vomiting as antecedents of esophagitis.

The proventriculus of the rat's stomach has the same type of epithelial covering as has the esophagus moreover it is well known that ulcer when observed in the rat's stomach is found almost invariably in the proventriculus (2, 3) similarly the burn ulcer is provoked readily in the rat's proventriculus (1, 2, 3). The pig's stomach has a fairly wide ring of esophageal epithelium around the esophagogastric juncture. It is just in that area that the histamine provoked ulcer is elicited regularly (6). In other words the squamous epithelium of the esophagus is more vulnerable to injury by the acid-peptic digestive juice than is the glandular epithelium of the stomach.

Ulcer is observed most frequently in the duodenum. And the reason probably is that it is the sole exit through which the entire output of gastric juice escapes from the stomach. Regurgitation of the acid digestive juice into the lower reaches of the esophagus is not an uncommon circumstance as manifested by acid eructations or a sensation of substernal burning. This occurrence also has been substantiated in the fluoroscopic observations of Robins and Jankelson (1926). They observed return of the barium mixture into the lower esophagus after being swallowed in 4.6 per cent of persons examined in the prone position. If all the gastric juice left the stomach via the esophagus esophagitis would in all probability be the most frequent of all clinical types of ulcer.

There is a growing conviction among clinicians dealing with the upper alimentary canal that hiatus hernia interferes with effective closure of the esophagogastric juncture, thus inviting periodic regurgitation of gastric juice into the lower reaches of the esophagus. Moreover Dey and his associates (1946) appear to have shown that the artificial creation of hiatus hernia in the dog leads to reflex shortening of the esophagus. They observed too that manipulation of the upper abdominal viscera led to contraction of the longitudinal muscle fibers of the esophagus with resultant reflex shortening. The fibrosis and contraction theory of the origin of so called thoracic stomach appears to account satisfactorily for many cases of congenitally short esophagus. In an able and critical review Smithers (1945) states that not infrequently patients in whom a diagnosis of congenitally short esophagus has been made by means of x ray examination are found later at surgery or on postmortem examination to have the entire stomach in the abdomen. In other words hiatus hernia may abet the ulcer diathesis not alone as it relates to the rather frequent association of gastric ulcer with the hernia but it appears also to be a forerunner of ulcer disease in the esophagus.

As one learns the natural history of a disease he interrogates more intelligently patients having some manifestation of that disease. We feel that in this experience we have been learning something of the natural history and a rather unexpected though probably not bizarre behavior of so called acid peptic ulcer. Esophagitis may be the only manifestation of ulcer. Every patient with a duodenal or gastric ulcer should be interrogated carefully with reference to the following: periodic sensation of burning in the esophagus; acid eructations and the tasting of food long after its ingestion; substernal pain difficulty in or pain on swallowing. And if in the roentgen-ray examination of every ulcer suspect great care is observed to note any abnormal behavior of the lower esophagus with reference to evidence of spasm, persistent narrowing or halting of the forward progress of the barium column into the stomach, the esophagitis form of ulcer disease would be recognized and diagnosed more frequently than it is.

The gastric mucosa is the most resistant to digestion of the natural membranes with the acid peptic digestive mixture contact. Investigators are still trying to answer the question posed by John Hunter more than a century ago: Why doesn't the stomach digest itself? When clinicians and roentgenists pool their information garnered in the light of the suggestion that esophagitis is a manifestation of ulcer disease, it may be that next to duodenal ulcer, esophagitis is the next most frequent variety of ulcer excruciating to patients in frequency. Certainly, patients with obstructive duodenal ulcer and vomiting esophagitis must be common. In case it is in the experimental animal a theory which will be amplified in a subsequent publication.

#### RATIONALE OF GASTRIC RESECTION FOR RELIEF OF ESOPHAGITIS AND ESOPHAGEAL STRICTURE

An effective gastric resection has two features which commend it as a suitable therapeutic agency for the relief of esophageal obstruction arising as a manifestation of ulcer disease. (1) It reduces the acidity and the digestive capacity of the juice secreted by the residual gastric pouch. A circumstance owing in part to the regurgitation of bile pancreatic juice and succus entericus from the short proximal duodenojejunal loop into the remaining gastric pouch. (2) Gastric resection quickens the gastric emptying time. Both these features are essential. In Case 2 reported herein, it was noted that whereas the pyloric obstruction disappeared following performance of gastrojejunostomy the functional manifestation of the esophagitis and esophageal stricture only came into evidence following that operation. In other words reduction of gastric emptying time alone is not effective therapy for esophagitis or esophageal stricture due to acid peptic ulcer of the esophagus. Effective simultaneous reduction of gastric acidity is also necessary. A gastric resection which fails to reduce gastric acidity effectually cannot overcome the ulcer diathesis and will prove

<sup>1</sup>Since this paper was written, good experimental evidence in the dog and rat has been obtained, indicating a far greater susceptibility of the esophageal over gastric mucosa to injury by the acid-peptic digestive juice.

no more effective in the relief of esophagitis and esophageal stricture of acid peptic origin than gastrojejunostomy.

The criteria of a satisfactory gastric resection for ulcer have been described elsewhere (7,8,14,15). Suffice it here to say that a three-quarter gastric resection carried out on the Billroth II plan of operation with a Hofmeister end to-side gastrojejunal anastomosis, with a short afferent duodenojejunal loop together with complete excision of the antral mucosa—these serve to constitute a satisfactory and effective gastric resection for ulcer (14).

Following gastric resection the pool of digestive juices accumulating periodically in the residual gastric pouch loses its capacity to irritate the lower reaches of the esophagus and with periodic dilatation of the esophagus for a few months after operation until the normal diameter is re-established (No. 45 French) the need for continual dilatation of the esophagus disappears. Whether a normal sized esophageal lumen will return in the patient described in the protocol of Case 6 who carried a gastrotomy for 8 years during which time he could not swallow his saliva remains to be seen. Certain it is that the less the penetration of the effects of the esophagitis into the deeper layers of the esophageal wall the more likely is restitution of a normal esophageal lumen to be achieved.

Some speculation as to whether cardiospasm and strictures of the lower end of the esophagus owing to the swallowing of lye might be helped by gastric resection seems warranted. In any case one of us (O. H. W.) feels that this thesis should be explored.

#### SUMMARY AND CONCLUSIONS

The case histories of 6 patients presenting clinical evidences of esophagitis, esophageal

stricture or both are cited in which relief of the esophageal obstruction followed gastric resection. Three of these patients (Cases 1, 3 and 6) had an associated duodenal ulcer one had a gastric ulcer (Case 5) one had a congenitally short esophagus and repeated hematemesis of unknown origin (Case 3). In Case 4 a boy of 17 there was a stricture of long length of the lower portion of the esophagus of unknown origin. Relief of the ulcer diathesis by a satisfactory gastric resection appears to be satisfactory treatment for esophagitis and esophageal stricture resulting therefrom as a corollary of this experience, it is suggested that these observations constitute strong evidence suggesting that esophagitis is a manifestation of ulcer disease.

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# SURGICAL TREATMENT OF PATENT DUCTUS ARTERIOSUS

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IT is only ten years since the first patent ductus arteriosus was ligated successfully by Gross (3). During this decade much has been learned about the surgical management of these cases. Although in general the operative procedure is fairly well standardized there still is considerable difference of opinion as to the best and safest method of closing the patent ductus. The medical world was greatly elated by Gross's success in getting a single ligature tied around the first ductus. Although no one wishes to shade the glory of the first success it is known today from the trial and error method that a single ligature tied snugly around a patent ductus is not sufficient to maintain occlusion in a considerable percentage of the cases. Gross (2) himself was the first to recognize this fact. He used double ligatures, tried injecting sclerosing solution between the ligatures, then added cellophane wrapping around the ligatures to stimulate snug closure by fibrosis. After treating 47 patients by these various methods and finding incomplete closure or recurrence of the fistula in 20 per cent, he abandoned methods of ligation and now routinely clamps, divides and sutures all patent ductus.

Although this attitude is not shared by all surgeons it appears to be making headway. Jones (4) in a series of 53 ductus ligations reports aortopulmonary fistula in 2 cases, 5 early recurrences of the murmur due to incomplete occlusion and 5 late recurrences of the fistula due to the tapes partially cutting through the wall of the ductus. Jones (5) now divides and sutures all ductus and in similar series has been highly pleased with his results.

Wangenstein has concluded that the ductus should be cut and sutured. He reports division of the ductus in 33 consecutive patients without mortality or recurrence.

Blalock, on the contrary, believes that double ligation, one suture placed well on the pul-

monary end, the other on the aortic end of the ductus, plus a transfixion suture between these ligatures, assures adequate closure. If there is any uncertainty about complete closure he adds a ligature of umbilical tape.

Shapiro in an analysis of 643 patients operated upon by 46 surgeons reports a mortality rate of 4.9 per cent and a recanalization rate of 8.7 per cent. He concluded from a study of 172 cases with uninfected ductus severed and sutured without mortality or recanalization that ligation of the patent ductus is now obsolete.

My attitude toward the surgical treatment of patent ductus arteriosus is colored by my own experience. To divide and suture a ductus is not a simple operation and should not be undertaken until one has familiarized himself on animals with the handling and suturing of large vessels. For trained surgeons to whom the opportunity of doing practice vascular surgery on animals has not been available I believe that proper ligation of a patent ductus is a safer procedure. Furthermore, any surgeon is wise to begin his operative work in this field on children because the operation is much easier in a child than in an adult.

At the Children's Memorial Hospital in Chicago the management of patent ductus has gone through two phases of surgical approach and surgical management.

In the first 12 cases an anterior submammary incision was made (Fig. 1). The chest was opened through the left third interspace and sufficient exposure was obtained by cutting the second and third ribs at the sternal margin. In children the ribs are pliable and the upper flap of ribs and attached muscle can easily be held aside with a claw retractor. A rib spreader may well be used but unless one is constantly on guard the lower flange is apt to rest against the heart and influence its rhythm unfavorably. In the next 28 cases a posterolateral approach has been used (Fig. 2).

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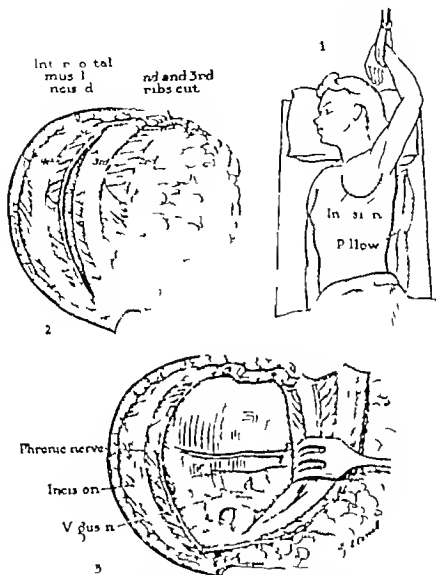


Fig. 4. Anterolateral approach to patent ductus arteriosus.

and the chest entered through the fourth left interspace. This incision is easier to make, gives better exposure, is easier to close and leaves a less conspicuous scar.

The first 22 consecutive patent ductus were ligated as illustrated in Figure 3. There was no mortality and to our knowledge there has been no recanalization. In spite of the latter fact which may well be coincidental and judged by the experience of others will undoubtedly change, and because of the fact that it is not the best surgery to bury large amounts of nonabsorbable foreign material on

large vessels and against a bronchus, investigation was undertaken for the development of a ductus clamp which would be effective, non-traumatic, and safe. It appears that such a clamp has been developed (Fig. 4). The basic feature of this clamp previously described (6) is embodied in a row of very fine teeth in the apposing jaws. The principle of the Indian fakir who walks on spikes has been applied to a clamp. He walks on spikes without injury to his feet only because he steps on many points at one time. Likewise a clamp with fine teeth can be applied to a vessel without

injury only because the many teeth distribute the pressure widely. The serrated portion of the jaws of the clamp 21 millimeters long and 1 millimeter wide is hollow ground so that at the base of the teeth it is about 0.5 millimeter wide. There are 40 teeth to the inch (16 to 1 cm). Each tooth is about 1 millimeter long. The bnb of the clamp is so constructed that the jaws can be closed to a point of complete apposition but not interdigitation of the teeth. When closed the teeth embed themselves in the adventitia and will not slip. Experimental studies on dogs indicate that any of the large vessels may be adequately occluded without tissue injury. It is important that these clamps be made of good well tempered stainless steel.

#### OPERATION

The operative technique as used on 18 consecutive patients is as follows (Fig 5). In tracheal anesthesia is used. A cannula or large needle is placed in the right saphenous vein at the ankle for the administration of fluids or blood if necessary. We routinely have in the operating room 500 cubic centimeters of blood. The child is laid on its right side and a curved incision is made beneath the left scapula. The chest is opened through the left fourth interspace. In children below 12 years rib resection is rarely necessary.

The lung is collapsed covered with a moist pad and held out of the way with a two-bladed retractor made of flexible monel metal. At this point it is important for the anesthetist to stop spontaneous respiration by breaking the Herring Brauer reflex and breathing for the patient by intermittent pressure on the anesthetic bag. By so doing the surgeon is greatly aided because movement of the diaphragm is stopped and with it the up-and-down motion of structures in the chest.

The phrenic nerve is easily identified and about 1 centimeter posterior to and parallel with it the mediastinum is opened. The ductus is readily located by palpating the point of maximum thrill. The vagus nerve and its recurrent laryngeal branch coursing around the ductus is next identified. A number of lymph nodes usually lying about the ductus are wisely dissected out and removed because they interfere with clear visualization.

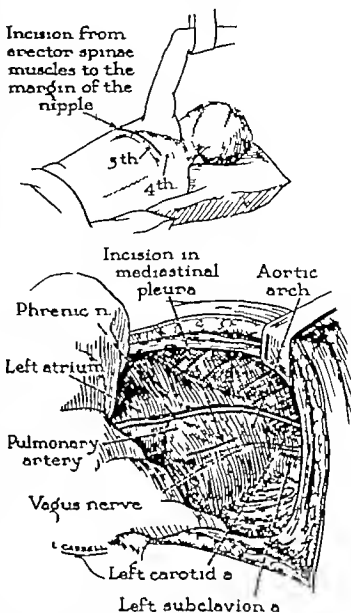


Fig 2. Posterolateral incision and surgical approach to patent ductus arteriosus.

Careful painstaking unhurried and adequate dissection of the ductus from its surrounding structures is the important step in this operation. A lappet of pericardial sac usually overlies the ductus and must be completely separated from it. The proper line of cleavage for this dissection is through the adventitial layer. (In one patient I failed to dissect the pericardium completely from the pulmonary end of the ductus. When the clamp was applied the teeth bled in the pericardium but one side of the cut ductus tended to retract and made suturing difficult.) The posterior portion of the ductus must be dissected from the bronchus blindly. Again if

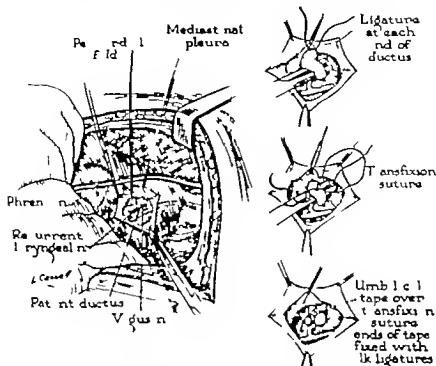


Fig. 3. Exposure of ductus and method of obliteration by multiple ligatures.

the line of cleavage through the adventitia is followed this step will be simplified.

After a curved cystic duct forceps has found its way beneath the ductus a strip of umbilical tape is drawn through to elevate it while the dissection is completed, first on the aortic side and then on the pulmonary side. The tape is then removed and while the ductus is elevated with a curved forceps the angled clamp is applied to the aortic end of the ductus. If the ductus is short the clamp is crowded as far as possible toward the aorta. While slight traction is being made on this clamp to elevate the ductus, the second clamp is applied on the pulmonary end.

With a long straight scissors designed by Dr. Sidney Smith, a small cut is made in the ductus. If no bleeding occurs (none has) it is completely severed midway between the clamps. The stumps distal to each clamp are usually 2 to 3 millimeters long.

The aortic stump is sutured first. No 5-0 Deknatel silk swaged on a curved No 9 atraumatic needle has been found very satisfactory. Until recently each stump was closed with a double row of a continuous over

and-over suture. Because occasionally there was some bleeding between the stitches we now use a continuous mattress suture all the way across the end of the ductus, then return with the same suture in an over-and-over manner at a slightly different level and tie the ends at the point where the sewing was begun. The clamp is partially released. If there is any bleeding the clamp is closed and an extra stitch or two is put in where necessary. A strip of gelfoam is then laid over the suture line and the aorta is retracted gently with a malleable retractor while the pulmonary end of the ductus is sutured in a similar manner.

The mediastinal pleura is closed with a few interrupted silk stitches. Just before the last stitch is drawn up penicillin 100,000 units in 1 cubic centimeter of water is sprayed over the ends of the sutured ductus. The lung is completely re-expanded by the anesthetist. A No 16 or No 18 F de Pezzer catheter with all but the flange removed is inserted from the inside out through a small puncture wound in the sixth interspace. The ribs are apposed with two catgut sutures about adjoining ribs. To avoid pressure on the intercostal nerve the

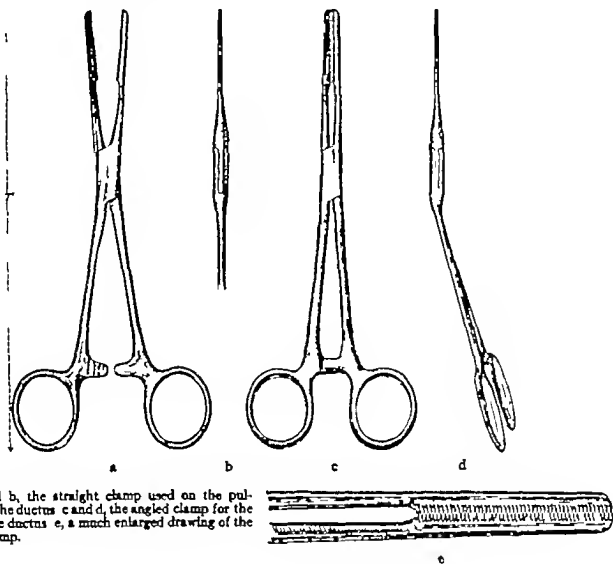


Fig. 4. a and b, the straight clamp used on the pulmonary end of the ductus c and d, the angled clamp for the aortic end of the ductus e, a much enlarged drawing of the teeth of the clamp.

suture about the lower rib is put in subperiosteally. The muscles are closed with a running catgut suture and the skin is closed with silk.

While the anesthetist makes pressure on the chest the drainage catheter is clamped. After the patient is returned to bed the catheter is attached to a water seal. On the second or third postoperative day the catheter is removed. Penicillin, 30 000 units every 3 hours is given intramuscularly for 5 to 7 days after operation routinely.

The results in the second group of 18 patients in whom the ductus was severed and sutured have been completely satisfactory. There were no deaths and no postoperative complications.

#### DISCUSSION

Mortality and morbidity statistics will all ways be lower in children because cardiac

reserve has not been depleted and because in children the ductus is longer, more elastic, and more easily freed from surrounding structures.

The diagnosis of patent ductus in this series of cases was made by Dr Stanley Gibson and confirmed at operation in every case.

The ages of these patients varied from 2 to 13 years. The most suitable age for operation is between the third and seventh year.

Postoperative complications although not troublesome occurred in the first group of patients. One child aged 4 had a severe postoperative tracheobronchitis and a collapse of the left lung. Both cleared spontaneously. Temporary paralysis of the recurrent laryngeal nerve occurred in two patients—the second and fourth child operated upon. Both of the injuries occurred because during dissection the proper line of cleavage was not followed and the ductus was accidentally

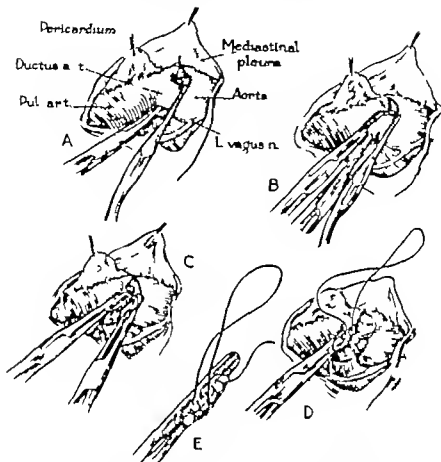


Fig. 5. Technique of division and suture of patent ductus arteriosus.

opened. In the rather panicky application of clamps the nerves were pinched.

We have had no reason to regret drainage of chest after operation: no case of empyema or infection around the tube has developed.

The outside diameter of the ductus was usually about 6 to 8 millimeters: some were as small as 4 millimeters others as large as 12 millimeters. One child aged 13 weighing 52 pounds, with a much enlarged heart on the verge of failure had a ductus which actually measured 18 millimeters in diameter. During the first two months after operation she gained 22 pounds.

#### CONCLUSIONS

1. Surgical obliteration of a patent ductus arteriosus has become an accepted procedure.
2. Whether the ductus should be ligated or divided is discussed.

3. Although 22 patent ductus have been successfully ligated it is believed that the preferable operation is division and suture.

4. Employing ductus clamps which utilize a new principle of safety 18 consecutive ductus have been divided and sutured.

5. There has been no mortality in either group.

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# ANATOMIC VARIATIONS OF THE EXTRAHEPATIC BILIARY SYSTEM AS SEEN BY CHOLANGIOGRAPHIC STUDIES

N FREDERICK HICKEN M.D. F.A.C.S.,  
Q B CORAY M.D. and BRUCE FRANZ, M.D., Salt Lake City Utah

CONTRARY to accepted opinions the gall bladder and the bile ducts present many variations in configuration and anatomical positions. Text books on anatomy fail to describe these anatomical aberrations thereby creating the impression that the extrahepatic biliary system follows an immutable structural pattern. Such inferences are not correct.

The fact that the gall bladder may be imbedded in, adherent to, or suspended from the ventral surface of the liver invites many positional variations. For example, in short stocky people the liver may be small and situated high under the costal margin thereby making the gall bladder a resident of the upper abdominal cavity. On the other hand, in the tall, ptotic individual the lower surface of the liver may extend below the crest of the ilium thus placing the gall bladder in the recesses of the lower abdomen. The bile ducts which pass down along the free edge of the hepatoduodenal ligament are not rigidly anchored and therefore have no constant position.

Our studies indicate that the bizarre structural pattern of the extrahepatic biliary system occurs with such regularity as to present a most annoying problem. How can the surgeon avoid injuring the misplaced ducts, perform plastic and reconstructive operations or even locate the elusive intraductal stones unless he is conversant with these variables? Likewise, the radiologist is unable to interpret contrast cholangiograms correctly unless he is familiar with these mutations.

The material herein presented represents roentgenographic visualizations of the extra-

hepatic biliary system obtained during and after operations on the biliary tract. These contrast cholangiograms were obtained by injecting radiopaque solutions such as diodrast, into the gall bladder and bile ducts and then exposing an x-ray film. The resulting cholangiogram gave an excellent roentgenographic pattern of the entire extrahepatic biliary system. Exact anatomical patterns of size, shape, and position of each segment of the biliary system were obtained.

A uniform technique was employed in all operative cholangiograms in order to minimize roentgenographic distortions. The Lys-holm grid was placed directly under the back of the patient in such a manner that it included the entire upper abdominal cavity. The x-ray tube stood 25 inches above the cassette and was centered on a point one inch above and one inch to the right of the umbilicus. The rays were directed perpendicularly to the cassette. All films were taken during a period of sustained apnea in order to minimize distortions resulting from motion of the thoracic cage. As all anesthetics were administered by endotracheal intubation it was possible to distend the lungs by positive pressure and thus suspend respiration until the cholangiogram was taken.

## OBSERVATIONS

A study of the cholangiograms reveal an amazing variation in size, shape, configuration and position of all components of the extrahepatic biliary system. Representative cases are presented.

**Gall bladder.** The visualized gall bladders represented in Figures 1 to 8 indicate that this organ may occupy any position in the right side of the abdominal cavity. It may rest against the lateral abdominal wall (Fig. 1),

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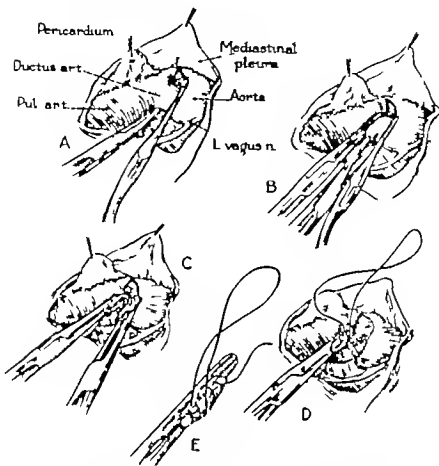


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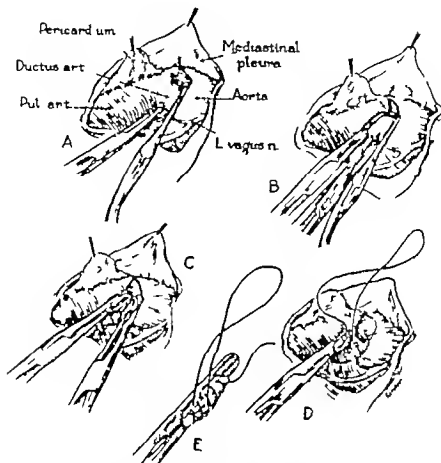


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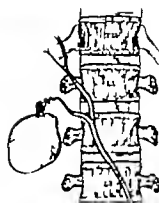


Fig. 4

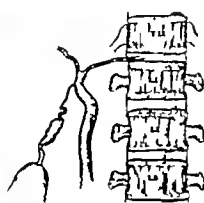


Fig. 5

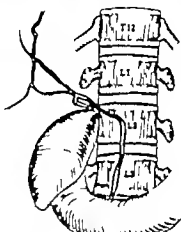


Fig. 6

Fig. 4. Operative cholangiogram. The small ovoid gall bladder hangs suspended from the ventral surface of the liver but it does not possess a pouch of Hartmann. The cystic duct passes upward, arches medially and then passes horizontally to unite with common hepatic duct, directly over the body of the second lumbar vertebra. The slender common duct passes diagonally downward and to the left as it descends over the bodies of the third and fourth lumbar vertebrae. Note that the papilla of Vater is practically in the midline, while in the former cholangiograms it lies lateral to the vertebral column.

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latter being mesial and ventral to its evacuating duct.

The manner in which the cystic duct forms its junction with the common hepatic duct is very interesting. As a rule the cystic duct empties into the right lateral wall of the common hepatic bile duct (Fig. 1). It may, however, open into the anterior surface of the common hepatic duct (Fig. 2) or even more rarely into the left mesial wall of the

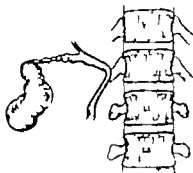


Fig. 1.

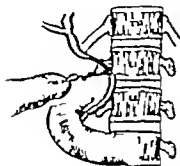


Fig.

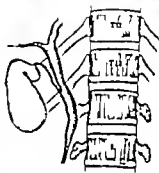


Fig. 3.

Fig. Postoperative cholangiogram obtained by injecting persisting external biliary fistula of 3 years duration with diodrast. The stone laden gall bladder occupies transverse position lying up under the 11th rib. Apparently the gall stones produced an intermittent obstruction of the cystic duct, thereby forcing bile and mucus out through external orifice of the fistula. The long, sacculated cystic duct passes medially in transverse plane to unite with the horizontally placed common hepatic duct. The choledochus first passes medially and then curves laterally so as to course down and to the right, thus forming a partial arc. Note that the papilla of Vater is placed lateral to the lower border of the body of the second lumbar vertebra.

Fig. Operative cholangiogram. The distended gall bladder occupies true transverse position. The tortuous, sacculated cystic duct courses medially in transverse plane

1 unit with the horizontally situated common hepatic duct. The cystic duct forms a junction with the anterior surface of the common hepatic duct rather than assuming the usual lateral position. Again the common bile duct assumes a half crescent shape as it passes down and to the right of the bodies of the first, second, and third lumbar vertebrae.

Fig. 3. Operative cholangiogram. This gall bladder assumes a vertical position as it is suspended from the ventral surface of the liver. Note the presence of Hartmann's pouch, which is not seen in Figures 1 and 2. The cystic duct descends along the lateral margin of the common hepatic duct for considerable distance before effecting its union. The choledochus assumes a bulb is considered a normal position, passing downward and slightly medially. The papilla of Vater is lateral to lower border of second lumbar vertebra.

or it may be superimposed over the body of the third lumbar vertebra (Fig 8). Occasionally it assumes a horizontal position (Fig 2) or it may hang downward so its fundus extends into the upper pelvic cavity as in Figure 5. Again the gall bladder can have an "S" shaped configuration (Fig 7) or resemble a small ovoid light globe (Fig 4). It may present a smooth pearshaped outline (Fig 6) or exhibit an irregular sacculated effect as in Figure 3. Rockwood encountered a gall bladder lying external to the muscles of the abdominal wall with a cystic duct which

insinuated its way between the fibers of the muscles and traversed the fascial planes and peritoneum until it reached the common hepatic bile duct. This evidence proves that the gall bladder does present many variations as to size, location, and shape.

**Cystic duct.** The positions of the cystic duct quite naturally varies with those of the gall bladder which it drains. The cystic duct may appear as a direct continuation of the gall bladder (Fig 1) or it may appear as a sacculated tube lying in a horizontal plane (Fig 2). Occasionally it courses upward turns

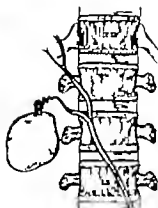


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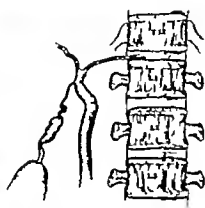


Fig. 5

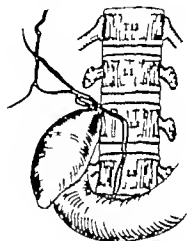


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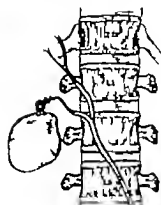


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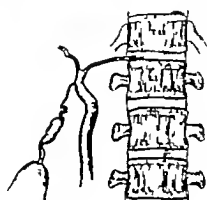


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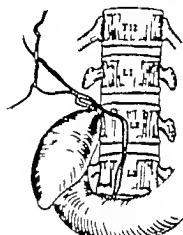


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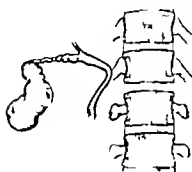


Fig. 2.

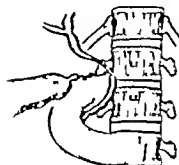


Fig. 3.

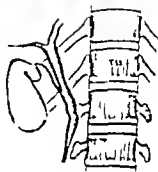


Fig. 4.

Fig. 2. Postoperative cholangiogram obtained by injecting iodizing external biliary fistula of 3 years duration with diodrast. The tone laden gall bladder occupies transverse position by tucking up under the 11th rib. Apparently the gall tones produced an intermittent obstruction of the cystic duct thereby forcing bile and mucus out through external orifice of the fistula. The long sacculated cystic duct passes medially, transverse plane to unite with the horizontally placed common hepatic duct. The choledochus first passes medially and then curves laterally so as to course downward and to the right thus forming a partial arc. Note that the papilla of Vater is placed lateral to the lower border of the body of the second lumbar vertebra.

Fig. 4. Operative cholangiogram. The distended gall bladder occupies true transverse position. The tortuous, sacculated cystic duct courses medially in transverse plane

to unite with the horizontally situated common hepatic duct. The cystic duct forms junction with the anterior surface of the common hepatic duct rather than assuming the usual lateral position. And the common bile duct assumes a half crescent shape as it passes downward and to the right of the bodies of the first, second, and third lumbar vertebrae.

Fig. 3. Operative cholangiogram. This gall bladder assumes a vertical position. It is suspended from the entral surface of the liver. Note the presence of Hartmann pouch, which is not seen in Figures 2 and 4. The cystic duct descends along the lateral margin of the common hepatic duct for a considerable distance before effecting its union. The choledochus assumes what is considered a normal position, passing downward and slightly medially. The papilla of Vater is lateral to lower border of second lumbar vertebra.

or it may be superimposed over the body of the third lumbar vertebra (Fig. 8). Occasionally it assumes a horizontal position (Fig. 2) or it may hang downward so its fundus extends into the upper pelvic cavity as in Figure 5. Again the gall bladder can have an S shaped configuration (Fig. 7) or resemble a small ovoid light globe (Fig. 4). It may present a smooth pearshaped outline (Fig. 6) or exhibit an irregular sacculated effect as in Figure 3. Rockwood encountered a gall bladder lying external to the muscles of the abdominal wall with a cystic duct which

innervated its way between the fibers of the muscles, and traversed the fascial planes and peritoneum until it reached the common hepatic bile duct. This evidence proves that the gall bladder does present many variations as to size location and shape.

**Cystic duct.** The positions of the cystic duct quite naturally varies with those of the gall bladder which it drains. The cystic duct may appear as a direct continuation of the gall bladder (Fig. 1) or it may appear as a sacculated tube lying in a horizontal plane (Fig. 2). Occasionally it courses upward turns



Fig 10.

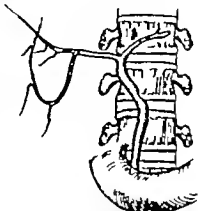


Fig 11

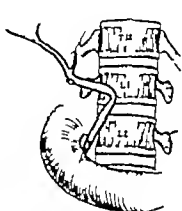


Fig 12.

Fig 10. Operative cholangiogram. The dilated common duct assumes a "half crescent shape" rather than descending in a vertical plane. The proximal segment is in a horizontal position while the distal portion passes downward and to the right. This produces an acute angulation. The shadow in the ampullary area represents an impacted stone.

Fig 11. Operative cholangiogram. The common hepatic bile duct and the choledochus traverse a vertical plane as they pass downward over the midportion of the second, third, and fourth lumbar vertebrae. The papilla of Vater

does not pass to the right of the vertebral column before penetrating the duodenal wall. The entire extrahepatic biliary system thus occupies a midline position.

Fig 12. Operative cholangiogram. The common hepatic duct assumes a transverse position as it passes medially to unite with the cystic duct over the midportion of the second lumbar vertebra. The proximal segment of the choledochus is in a horizontal plane. It then angulates and passes downward to the right. Angulation of the choledochus is of common occurrence.

**Choledochus** The common bile duct has no constant pattern or position. The text book description is depicted by Figure 5 wherein the choledochus descends along the lateral margin of the hepatoduodenal ligament lying lateral to the right margins of the bodies of the second and third lumbar vertebra. As the retroduodenal segment of the choledochus penetrates the duodenal wall it curves laterally so the papilla of Vater is more laterally placed than any other portion of the duct (Figs. 1 3 7 10 12). However the choledochus may pass downward in a vertical plane (Figs. 6 11) or it may travel in a left oblique direction (Fig 4) or it can transcribe a zig zag pattern as in Figure 13. In many instances the common bile duct lies directly

over the bodies of the second and third lumbar vertebra, rather than being lateral to them. Again the choledochus may form a definite semicircle (Figs. 2 10 13) or it may lie in a horizontal plane (Fig 15). One is amazed at the inconstant anatomical patterns presented by the common bile duct and this may account for some of the difficulties which the surgeon encounters when he attempts to extirpate intraductal stones.

#### GENERAL CONSIDERATIONS

It is apparent that the surgeon must be conversant with the anatomical variants of the extrahepatic biliary system if surgical treatment is to be effective. True the gall bladder can usually be found by exposing the





Fig. 7



Fig. 8

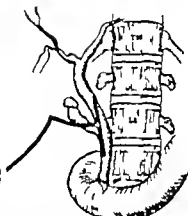


Fig. 9

Fig. 7. Operative cholangiogram. The "S" shaped gall bladder is transversely placed so it lies under the eleventh rib. The long, tortuous, dilated cystic duct assumes an unusual pattern. Note how it first passes upward, then arches medially so it lies anterior to the common hepatic bile duct. It then passes downward along the medial margin of the common hepatic duct so the two are contiguous. The choledochus has normal position with the papilla of Vater being lateral to the lower border of the second lumbar vertebra.

Fig. 8. Operative cholangiogram. The fundus of the contracted gall bladder lies in the midline directly over the body of the third lumbar vertebra, while the cystic duct passes first to the right, then upward, and finally to the left to join the common hepatic duct over the midportion of second lumbar vertebra. The first portion of the dilated choledochus passes transversely across the body of the

second lumbar vertebra, angulates and descends over the left side of the third lumbar vertebra. The ampulla of Vater was not visualized because it contained several stones which had displaced the contrast media.

Fig. 9. This postoperative cholangiogram depicts the normal position of the bile ducts. The common hepatic bile duct descends in a vertical direction just lateral to the bodies of the first and second lumbar vertebrae. The choledochus which is formed by junction of the cystic and common hepatic ducts at the level of the lower margin of the second lumbar vertebra, and from here it descends in vertical plane. The ampulla of Vater was not visualized because it contained several stones which had been overlooked at the primary operation, but despite this obstruction much of the duodenum had escaped into the duodenum. Note the long, dilated stump of the cystic duct resulting from the hydrostatic pressure incident to the ampullary obstruction.

common hepatic duct as the two form the choledochus (Fig. 7).

**Common hepatic bile duct.** The common hepatic duct is usually formed by a union of the right and left hepatic ducts at the level of twelfth thoracic vertebra. It is generally believed that the newly formed common he-

patic duct descends along the free edge of the hepatoduodenal ligament in a vertical plane (Fig. 3) but it was interesting to observe the frequency with which it assumes a horizontal position (Figs. 1, 2, 8, 12, 15). This horizontal pattern must be kept in mind when exploring this duct for floating calculi.

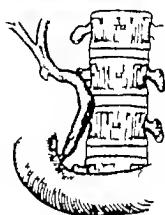


Fig 10

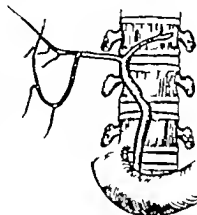


Fig 11

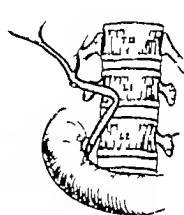


Fig 12.

Fig 10 Operative cholangiogram. The dilated common duct assumes a "half crescent shape" rather than descending in a vertical place. The proximal segment is in a horizontal position, while the distal portion passes downward and to the right. This produces an acute angulation. The shadow in the ampullary area represents an impacted stone.

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over the bodies of the second and third lumbar vertebra rather than being lateral to them. Again the choledochus may form a definite semicircle (Figs. 2, 10, 13) or it may lie in a horizontal plane (Fig. 15). One is amazed at the inconstant anatomical patterns presented by the common bile duct and thus may account for some of the difficulties which the surgeon encounters when he attempts to extirpate intraductal stones.

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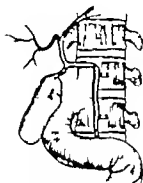


Fig. 3.

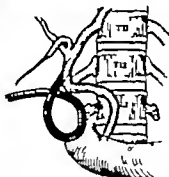


Fig. 4.



Fig. 5.

Fig. 3. Operative cholangiogram. The common hepatic duct lies lateral to the body of the first lumbar vertebra. Here it unites with the cystic duct. The proximal portion of the choledochus is horizontally placed. It then forms a right angle turn and passes downward in the midline. The common hepatic and choledochus thus produce a "stair step" pattern.

Fig. 4. Postoperative cholangiogram. The common hepatic duct lies high in the abdominal cavity lateral to the right margin of the twelfth thoracic vertebra. The choledochus forms a semicircle as it arches medially and then passes

down and to the lateral border of the third lumbar vertebra.

Fig. 5. Operative cholangiogram. This patient had a large carcinoma of the head of the pancreas which was obstructing the ampulla of Vater. Note the dilated common hepatic duct which lies in a horizontal plane. The cystic duct unites with the posterior surface of the common hepatic duct. The dilated common bile duct has been pushed upward and medially so it traverses a direct horizontal plane. The ampulla of Vater is displaced to the left of the third lumbar vertebra. Appreciation of these transverse positions is essential for correct surgical approach.

ventral surface of the right lobe of the liver but in Figures 5 and 8 the gall bladders have no contact with the liver except by means of the common hepatic duct and its two hepatic tributaries. In one instance we found an elusive gall bladder in the lesser omental cavity. Indeed it was so well hidden that the surgical notes of the two earlier operations stated that the gall bladder was missing. When dealing with an acute suppurative cholecystitis the problem of locating the gall bladder is much more complicated. If the inflammatory process has spread to the stomach, duodenum, pancreas, colon, and omentum one

may experience great difficulty in isolating the enmeshed but distended gall bladder. For example, if the gall bladder seen in Figure 8 should become acutely inflamed it might readily be mistaken for a pancreatic, mesenteric or duodenal cyst because of its unusual location.

In a recent publication we have emphasized the manner in which the cystic duct can and does complicate surgery of the biliary system. When the cystic duct is short and effects an immediate fusion with the common hepatic duct both of these structures may be included by the cystic duct ligature. When the cystic

duct descends along the side of the common hepatic duct the surgeon may leave a long residual stump which eventually becomes dilated and produces the reformed gall bladders of Beye (Fig 9) Should the cystic duct cross over the common hepatic duct and unite with its medial wall then the laterally placed common hepatic duct could be mistaken for the cystic duct, ligated and thus produce an obstructive jaundice (Fig 7) These errors of commission can best be minimized by obtaining cholangiographic visualizations of the biliary system prior to clamping or ligating any of the ducts.

The choledochus has always been a surgical puzzle. Even when the surgeon locates the duct he is never certain that all of the offending calculi have been removed. The large number of patients requiring secondary operations on the biliary tract provides adequate proof that such a problem exists. The angulations, unusual configurations and the anatomical displacements of the common bile duct merely increases the inefficiency of intraductal explorations. One has but to study Figures 6, 8, 13, 14, 15 to appreciate some of the problems which confront the surgeons during these intraductal explorations.

When the common bile duct presents any unusual configuration or position it is an easy matter to force an exploring probe through the duct wall thus forming an internal biliary fistula. In observing numerous operators probing the common bile duct they all attempt to pass the probe downward in a vertical plane believing this to be the normal position of the choledochus. When rigid instruments are forced along the lumen of the angulated choledochus traumatic perforations may ensue. Such errors can be completely eliminated by first determining the exact configuration of the bile ducts by means of cholangiographic studies.

During the past 13 years it has been our practice to obtain a visualizing cholangiogram as soon as the abdomen is opened before any portion of the extrahepatic biliary tract has been disturbed. This can be accomplished by introducing a solution of diodrast into the gall bladder or the bile ducts and then taking an x ray film. Within a period of 10

minutes the radiologist presents the surgeon with an accurate roentgenographic pattern of all components of the biliary system. These visual patterns have been very helpful in determining the type of corrective operation to be employed.

#### SUMMARY

1. Roentgenographic studies of the extrahepatic biliary systems of patients during and after operations have been made. This was accomplished by injecting a solution of diodrast into the gall bladder or bile ducts and then taking an x ray film. These cholangiographic studies present accurate roentgenographic outlines denoting the size, shape, configuration and anatomical position of each segment of the extrahepatic biliary system.

2. The gall bladder was found to occupy almost every position in the right side of the abdominal cavity. It was seen to lie under the eleventh rib to be contiguous to the right lateral abdominal parietes to be pushed so far medially as to superimpose the body of the third lumbar vertebra and even to hang down into the recesses of the pelvic cavity.

3. The cystic duct was seen to pass medially in a horizontal plane to descend vertically downward toward the lateral border of the third lumbar vertebra to ascend perpendicularly from a gall bladder situated in the pelvic cavity or to describe a tortuous course as it passes mesially to unite with the common hepatic bile duct. It was noted that the cystic duct united with the right lateral wall, the anterior surface or even the left mesial wall of the common hepatic bile duct. There seemed to be little uniformity in pattern.

4. The common hepatic duct was usually noted as passing downward and medially to unite with the cystic duct. At times however it occupied a horizontal position.

5. The choledochus presented no uniform pattern. In some instances it descended in a vertical plane again it was found to lie in a transverse position. Sometimes it appeared as a vertical tube then again it would present a zigzag outline or even be so distorted as resemble the letter S. Occasionally it presented a tortuous contour even transcribing semicircular forms. At times the cho-



# A RATIONALE FOR THE SURGICAL TREATMENT OF DUODENAL ULCER

R. ARNOLD GRISWOLD M.D., F.A.C.S., Louisville, Kentucky

THE most rational explanation for the maintenance of chronic peptic ulcer in the human is the inability of the mucosa to withstand the proteolytic activity of the gastric contents. This may be due to (a) lowered resistance of the mucosa, including alteration of its protective mucous secretion (b) increased proteolytic activity of the secretion including reduction of the diluting and neutralizing influence of saliva and upper intestinal contents or (c) a combination of these factors.

While acute peptic ulcer may be initiated in the experimental animal by numerous etiological factors, chronic ulcer is maintained only by a persistent reduction of the mucosal resistance-proteolytic activity ratio (4 21). The formation of a chronic jejunal ulcer following the Mann-Williamson operation depends upon shunting of the strongly alkaline biliary pancreatic and other upper intestinal juices away from the gastric outlet so that undiluted unneutralized gastric contents impinge on the jejunal mucosa (19 20). The production of peptic ulcer by histamine or caffeine implantation depends upon increasing the proteolytic digestion (5 16 24 27, 37). Lysozyme by degrading the mucosa of its protective mucous coating may predispose to ulceration (22 23). Vascular or other nutritional factors may reduce mucosal resistance (4 30).

The chief mechanisms for the stimulation of gastric secretion are the humoral and vagal phases (Fig 1). The humoral phase is normally initiated by the action of food on the pyloric part of the stomach or in the intestine (6 14 33 34). It may also be brought about by alcohol, caffeine or histamine (8, 24 26, 27 28). The vagal (cephalic) phase depends upon the transmission down the vagus nerve of impulses that originate in the higher centers because of normal (thought, smell or taste of

food) or abnormal (emotional) psychophenomena (3 9 36). The vagal phase may also be increased by organic brain lesions or hypoglycemic stimulation of the nerve center (7, 15). An important factor in gastric secretion is the fact that the gastric juice secreted by the humoral route is high in acid but low in pepsin while the secretion initiated by vagal stimulation is not only high in acid but also high in pepsin (3 13).

Clinically, it has been convenient to use the acidity of the gastric contents in quantity and concentration as a measure of the proteolytic activity of the gastric secretion and most efforts at the treatment of peptic ulcer have been aimed at reduction or neutralization of the acidity of the gastric juice. It is generally forgotten that it is the pepsin activated by the acid which is the true measure of proteolytic activity and that the concentration and amount of acid present in the gastric secretion is not necessarily a true parallel of the proteolytic activity of that secretion (17 18).

Most methods of treatment have been aimed at modifying or reducing gastric secretion without reference to the cause of the excess secretion in that particular case. Among the medical treatments diet and antacids have been used to neutralize excess acidity. Sedative depressants have proved useful. Rest (both emotional and physical) is widely recognized as beneficial—probably by reducing emotional stimulation of the vagus. Gastrojejunostomy, subtotal gastrectomy and vagotomy have been most popular surgical procedures. Gastrojejunostomy is effective in many cases by relieving pyloric obstruction, and what is probably more important by allowing a reflux of alkaline jejunal contents to neutralize gastric acidity. Subtotal gastric resection has aimed at suppressing the humoral secretion, and in addition unless a Billroth I type of anastomosis is performed takes advantage of the neutralizing action of gastro-

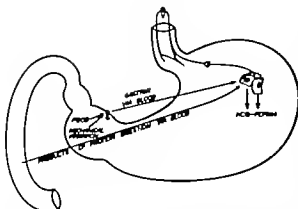


Fig. Mechanisms for stimulation of gastric secretion. V Origin of vagal impulses from the central nervous system. G Site of formation of gastrin. This is limited to the pyloric part of the stomach. Nervous (vagal) phase of gastric secretion stimulated by ( ) emotional factors, ( ) hypoglycemia, ( ) taste, thought, or smell of food, ( ) intracranial lesions. Humoral phase of gastric secretion stimulated by ( ) food in pyloric part of stomach, ( ) mechanical irritation of pyloric part of stomach, ( ) products of protein digestion after absorption by intestinal mucosa, ( ) histamine, caffeine, or alcohol in blood or stomach.

jejunostomy (2 39) It also removes a variable amount of gastric mucosa. In the last few years vagotomy has been popularized to abolish the vagal secretion.

The work of Dragstedt and others on sections of the vagus nerve has awakened a renewed interest in the physiological background of peptic ulcer and has stimulated a search for better methods of surgical treatment (25 29 35). There have now been enough vagus sections reported to indicate that neither vagotomy nor gastric resection alone is the final answer to all cases of peptic ulcer (1 10 38). From the recent literature it would appear that the recurrence rate of ulcer following either gastric resection or vagotomy is about equal. The undesirable side-effects of the two operations are comparable. The mortality rate following vagotomy is probably considerably less than that following gastric resection. Gastrojejunostomy is still a useful operation either alone or in conjunction with subtotal gastric resection or vagotomy although when used alone it does not give as high a percentage of cures as do either resection or vagotomy and is frequently followed by gastrojejunal ulcer.

With the foregoing facts in mind and the probability that there are two factors (vagal

and humoral) concerned with the maintenance of peptic ulcer it occurred to us that it would be useful to determine which secretory mechanism is predominant in a given case before carrying out any operative procedure in an attempt to abolish the abnormal mechanism. Actually the question is, should the humoral phase of gastric secretion be modified by subtotal gastric resection, or should the cephalic phase be abolished by vagotomy?

Our present concept of ulcer maintenance may be illustrated as in Figure 2. The line, ulcer threshold, is a level of mucosal resistance including such factors as the amount of mucous and other protective mechanisms. This level probably varies in different patients and from time to time in the same patient. Gastric secretion, in amount and concentration exceeding this threshold, would cause maintenance of an ulcer. Spontaneous or seasonal remissions and exacerbations of peptic ulcer show that the ratio of proteolytic activity to mucosal resistance may vary from time to time. From the fact that the majority of ulcers may be healed by abolishing either the humoral or vagal phase (subtotal resection or vagotomy) it would appear that in most of them the situation would be somewhat as shown in column 1 where the suppression of either the humoral or vagal secretion would bring proteolytic activity below the threshold line. However in column 2 in which the vagal secretion exceeds the threshold, it would appear that vagotomy would heal the ulcer while gastric resection would result in recurrence or gastrojejunal ulcer. Likewise, in column 3 vagotomy would be ineffective in controlling the ulcer while gastric resection would bring the column below the threshold line.

Working according to this hypothesis we have attempted to differentiate between the humoral and vagal factors in ulcer patients by performing preoperative studies of the comparative response to humoral and to vagal stimulation. The functions tested are secretory rate, emptying rate (a function of gastric motility), peptic power and least important

\*The gastric function studies reported in this work were developed and carried out by Dr. Arthur M. Schoen of the Department of Medicine and Pharmacology of the University of Louisville School of Medicine under grant from the National Institute of Health.

of all, acidity. The secretory rates and emptying rates are calculated according to the methods of Schoen (31, 32). Peptic power is measured by a modification of the method of Mett (12), and the hydrogen ion concentration is measured electrometrically.

We have been able to differentiate in the few cases thus far studied between one group which seems to respond predominately to vagal stimulation and another group which seems to respond predominately to humoral stimulation as measured by secretory rate, emptying rate, and output of pepsin and hydrochloric acid. A third and probably the largest group seems to respond almost equally well to either stimulus. The following case reports represent an example from each group.

**CASE 1:** Predominate response to vagal stimulation (Fig 3 and Table I). Patient L. S. 63 year old white male with symptoms of peptic ulcer disease for 30 years had melena in November, 1947. He had 3 episodes of marked gastric retention between December 1947 and April 1948. There was fluoroscopic and x ray evidence of crater in duodenal bulb, marked duodenal deformity and 40 per cent retention of barium at 5 hours on November 24, 1947. Celiotomy performed on April 29, 1948 revealed marked duodenal deformity with induration and scarring. Symptoms of gastric retention and pain were subsiding at the time of the gastric function studies on April 22, 1948. The average values of basal function during the three control periods were: peptic power 4,000 units per cubic centimeter free acidity 34 clinical degrees (milliequivalents per liter) secretory rate, 0.77 cubic centimeter per minute emptying rate, 1.21 cubic centimeters per minute. The average rate of secretion of free hydrochloric acid (hydrogen ions) was 0.0262 milliequivalent per minute and the average rate of secretion of pepsin was 3,100 units per minute (not shown in Fig 3).

The high peptic power of the control (basal) secretion is strongly suggestive of a high concentration of vagally stimulated gastric juice. The accompanying low rate of basal secretion of essentially normal acidity indicates a low output of hydrochloric acid and mucus during the control periods. The differences in emptying rates between the three control periods are within the range of a normal healthy individual.

Histamine had the usual influence on the rate of secretion of hydrochloric acid. The output of free hydrochloric acid was increased

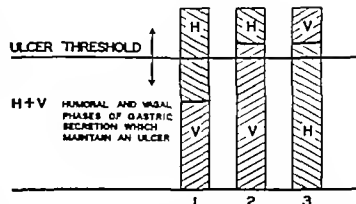


Fig 2. Concept of peptic ulcer maintenance. When column exceeds the threshold, the ulcer is maintained. Patients represented by column 1 should benefit from either vagotomy or subtotal resection. Those represented by column 2 should benefit from vagotomy but not from subtotal resection. Those of column 3 should benefit from subtotal resection but not from vagotomy.

from 0.0262 to 0.563 milliequivalent per minute (not shown in Fig 3). The acidity of the gastric juice was increased from 34 to 125 clinical degrees (milliequivalents per liter). While the peptic power of the gastric juice was diminished following the injection of histamine, the actual output of pepsin from the mucosa was increased during the first period after the histamine injection (18½ minutes) from 3,100 to 8,000 units per minute (not shown in Fig 3). This increased output of pepsin by the gastric mucosa following the injection of histamine has been attributed to the "washing-out" by the increased secretion of the parietal cells of the gastric crypts and alveoli which contained a normal accumulation of secretion from the acid and pepsin secreting cells. The rate of pepsin output at the time the maximum rate of histamine stimulated gastric secretion occurred was only 1,580 units per minute. The increase in the rate of gastric emptying was due partly to the increased volume of gastric contents as a result of the increased secretory rate. There was an initial depression of the emptying rate following the injection of histamine.

Insulin hypoglycemia produced a much higher rate of gastric secretion and emptying than did histamine. The increase of gastric function was preceded by a depression of all components. This latter phenomenon has occurred consistently in all people after the injection of insulin. The maximum rate of pepsin output during insulin hypoglycemia was



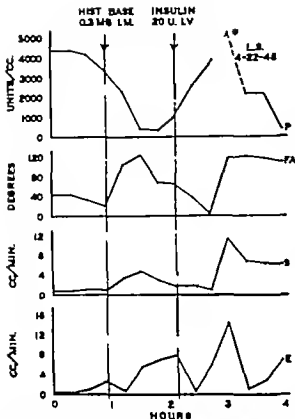


Fig. 3. Gastric function of one whose predominates response was to vagal stimulation. P, Peptic power of residual gastric juice, end of test period adjusted to per cent. FA, Free acidity of residual gastric juice at end of test period. S, Average secretory rate during test period. E, Average emptying rate during test period. Alabala tubes were digested completely minimum peptic power 5,200 units per cubic centimeter.

60,400 units per minute which is far in excess of either the basal rate (3,100 units per minute) or the maximum rate following the injection of histamine (8,000 units). This maximum rate of pepsin output occurred during the period when secretory rate was also a maximum.

Although the maximum concentration of free hydrochloric acid in the histamine stimulated gastric juice was essentially the same as the maximum attained during hypoglycemia (125 and 124 clinical degrees) the maximum rate of secretion of free acid following histamine was 0.563 milliequivalent per minute as compared with 1.380 milliequivalents per minute during insulin hypoglycemia (not shown in Fig. 3).

TABLE I.—SUMMARY OF THE RESPONSES OF GASTRIC FUNCTION TO HISTAMINE AND INSULIN HYPOLYCEMIA

Case No. Initial	Average values of basal function (during 3 rapid periods)	Average values for period of maximum response to histamine	Average values for period of maximum response to insulin
Peptic power <sup>1</sup> units per			
L.S.	4000	5300	3700
E.W.		780	
A.M.	500	100	5000
Peptic output <sup>1</sup> units per min.			
L.S.	3500	8000	60400
E.W.		300	
A.M.	1600	4500	7000
Peptic output when secretory rate was maximum, units per min.			
L.S.	4000	380	60400
E.W.		2500	480
A.M.	30	3500	7000
Free acidity <sup>2</sup> clinical degrees			
L.S.	54	75	84
E.W.		54	
A.M.	59	83	86
Free acid output <sup>2</sup> mEq. per min.			
L.S.	5063	543	380
E.W.		175	
A.M.	302	350	282
Secretory rate, per min.			
L.S.	37	30	8
E.W.	3	3.5	
A.M.	84	4.80	3
Emptying rate, c. per min.			
L.S.		7.78	14.8
E.W.	30	40	
A.M.	54	4.00	4

<sup>1</sup> Unit per c.c.—same as Malt unit except that exponent of 5 was used for calculating peptic power.

<sup>2</sup> Peptic output—peptic power X secretory rate.  
Free acid output—milliequivalent of acid per liter of gastric juice.  
Free acid output—free acidity X secretory rate.

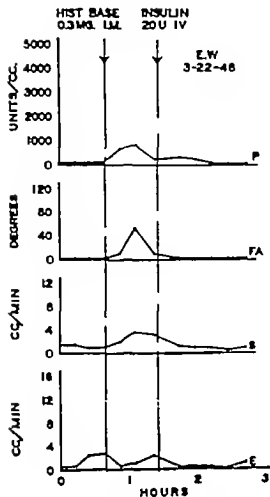


Fig. 4. Gastric function of one whose predominate response was to humoral stimulation.

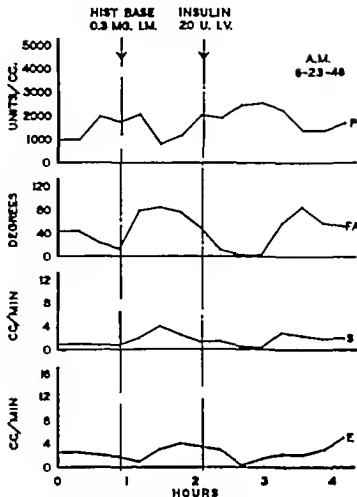


Fig. 5. Gastric function of one whose response was about equal to vagal and humoral stimulation.

**CASE 2.** Predominate response to humoral stimulation (Fig 4 and Table I). Patient E. W. 62 year old white male with recurrent symptoms of peptic ulcer for more than 6 years showed evidence of complete obstruction in February 1948. A ray examination on March 15, 1948 showed 60 per cent retention of barium at the end of 5 hours. Cellotomy performed on March 26, 1948 revealed evidence of duodenal ulcer and marked scarring of the first part of the duodenum. The pyloric obstruction was subsiding at the time of the gastric function studies on March 22, 1948. The average values of basal gastric function during the three control periods were: peptic power 0 units per cubic centimeter, free acidity 0 clinical degrees (milliequivalents per liter), secretory rate, 1.15 cubic centimeters per minute, emptying rate 1.90 cubic centimeters per minute.

The absence of active pepsin and hydrochloric acid ( $\text{pH}$  of the basal secretion was 7.0) in the gastric juice of the control periods suggests that the nervous phase of gastric secretion was acting not at all or very little. With no food in the stomach or intestines the humoral phase also would not be acting hence

the absence of acid and pepsin in the basal secretion. A small amount of acid or pepsin could have been neutralized by mucous secretion.

Histamine increased the secretory rate and stimulated the production of hydrochloric acid. The response to histamine in this patient was less in every respect than the response in patient L.S. (Fig 3). The presence of pepsin in the histamine stimulated gastric juice, again could be due to the 'washing-out' process mentioned under Case 1. This would imply however that some pepsin had been present in the gastric alveoli previous to the injection of histamine. Whether it had been produced during the basal periods by either the nervous or humoral phases cannot be determined. Histamine again caused an initial depression of the emptying rate which was followed immediately by an increased rate of emptying.

During the 10 minute period immediately following the injection of insulin there was a marked decrease in all components of gastric function. This phenomenon occurs whenever insulin is injected. The increase of gastric function which usually follows the initial period of inhibition did not occur in this person (Fig 3). Instead there was a persistence of the state of diminished gastric activity. The initial increase of the peptic power following the injection of insulin resulted from the decreased secretory rate and does not represent an increase in the output of pepsin. Actually the output of pepsin dropped from 570 units per minute to 460 units per minute during the 10 minute period following the injection of insulin and it continued to drop to zero (not shown in Fig 4).

**CASE 3.** Equal response to vagal and humoral stimulation (Fig 3 and Table I). Patient A. M. 47 year old white male with history of peptic ulcer for 10 years had a massive hemorrhage in April, 1943. X-ray examination and fluoroscopy showed crater in duodenum and clover leaf deformity of the pyloric cap on June 22, 1943. Typical symptoms of peptic ulcer were subsiding at the time of the gastric function studies on June 23, 1943. The average values of basal gastric function during the three control periods were: peptic power 1,600 units per cubic centimeter free acidity 29 clinical degrees (milliequivalents per liter) secretory rate 1.04 cubic centimeters per minute emptying rate 2.24 cubic centimeters per minute. The average rate of secretion of free hydrochloric acid (hydrogen ions) was 0.0302 milliequivalent per minute, and the average rate of secretion of pepsin was 660 units per minute (not shown in Fig 5).

The lower concentration of pepsin in the basal secretion of this person as compared with the pepsin concentration in the basal secretion of patient L.S. (Fig 3) suggests a lower concentration of vagally stimulated gastric juice. The pepsin output of this patient under basal conditions was 1,660 units per minute which is less than one-half of the pepsin output of patient L.S. under similar conditions. A comparison of the acidities and secretory rates of the basal secretions of this person with patient L.S. suggests that in this person there was relatively a higher rate of secretion of nonacid and nonpepsin constituents (mucous secretion).

Comparisons of the maximum responses to histamine and insulin show that histamine

stimulated the secretion of hydrochloric acid slightly more than did insulin hypoglycemia (0.340 milliequivalent per minute for histamine, and 0.224 milliequivalent per minute for insulin hypoglycemia). Secretory rate also was stimulated somewhat more by histamine (4.0 c.c. per minute for histamine, and 3.10 c.c. per minute for insulin). However peptic power output of pepsin and emptying rate were all stimulated more by insulin (Table I).

We are now basing our operative therapy on the differentiation of duodenal ulcer patients into the groups as shown by these tests, doing subtotal resections on those patients who respond predominately to humoral stimulation and vagotomy on those responding predominantly to vagal stimulation. In the third group in which it would seem that equally good results would follow either procedure, the choice of operation may depend upon factors other than the gastric function studies. The gastric resections performed are the standard high resections with care to remove all antral tissue. Continuity is usually re-established by anterior Polya gastrojejunostomy. Vagotomy is carried out transthoracically unless there is a special indication for abdominal exploration or unless gastrojejunostomy is to be added to the vagotomy. No gastric ulcers are included in this study since we believe that the incidence of unsuspected carcinoma in gastric ulcer is so high that any procedure which does not involve resection of the ulcer is dangerous. It is also believed that gastric ulcer results from a different condition than duodenal or jejunal ulcer not having the same age incidence, sex incidence, or necessarily the same physiological characteristics. Gastrojejunostomy is performed in addition to vagotomy on all patients whose stomachs are not empty at the end of 2 hours following the ingestion of barium. While it is realized that a normal stomach may retain barium as long as 5 hours, it is felt that in the hypertonic, hypermotile stomach with ulcer any retention beyond 2 hours indicates relative pyloric obstruction and that symptoms of retention may occur unless a drainage operation is combined with the vagotomy. It has been argued that the addition of gastrojejunostomy prevents a thorough evaluation of vagotomy. On

the other hand, gastric resection of the Polya Hofmeister or similar types also takes advantage of gastrojejunostomy by bringing the alkaline jejunal contents to the most vulnerable spot, which is the area of the anastomosis.

It is evident that it will require many cases handled according to this method followed over a period of years to test the validity of our hypothesis. This work is presented in its present early stage in the hope that others who are interested in the problem of peptic ulcer may work along similar lines to prove or disprove this hypothesis in a shorter time than we would be able to do alone and to develop practical tests of gastric function which will give more adequate information in planning a rationale of treatment than have the tests which are in general use.

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Figs 1 and 2 S B 42-132. Elastica, Fig 1 left  $\times 16$  Fig 2  $\times 88$  Origin traumatic. Operation revealed a ruptured disc at the fourth lumbar vertebra. Pathologically, the lamellae of the annulus fibrosus are partly preserved, partly destroyed. The inner lamellae are increasingly necrotic (IL, Fig 1). The disc proper shows dense hyaline cartilage with gradual thinning into fibrous cartilage and reticular dissolution around numerous large cartilage cells (Fig 2). No part of the nucleus pulposus was found. Result good in the beginning 5 years after operation, patient complained of moderate sciatic pain in the left buttocks and was dissatisfied with the result.

#### GROUP I

The poorest results were found in the 15 patients of our first group namely in discs which the surgeon described as *bulging*. This term is meant to indicate that the posterior part of the annulus fibrosus protruded upward without any visible lesion of the annulus or the cartilage. This form seems to correspond with what has been called *hidden disc*. It was assumed that this anomaly was the cause of the clinical symptoms and signs. Hence the annulus was incised and the allegedly diseased disc material removed.

Histopathological examination of the biopsy material fails to show any abnormality. It contains normal lamellae of fibrous cartilage sometimes with adherent gelatinous tissue.

Results Not more than one third of the persons in this group experienced reasonable benefits from operation. The inference is that in those not improved the bulging annulus had not been the cause of the complaints. Gurdjian<sup>1</sup> states that in his experience persons with bulging disc and good operative results had shown invariably the typical defect in the myelogram and had suffered traumatic lesions.

Personal communications.

of the disc lamellae without a visible rent in the annulus. Mixter<sup>1</sup> takes exception to the last part of this opinion. He believes that a small rent of the annulus may be easily overlooked unless the patient's spine is over stretched during operation.

A bulging disc results from a paunchy posterior annulus fibrosus without rent in the annulus and without detachment of the disc from the bone. It should not be incised unless there is definite evidence of its encroachment upon a posterior root.

#### GROUP II

In our second group a rent in the annulus fibrosus was found during operation through which disc material was *herniating* into the spinal canal. A spinal root was found hooked up over it.

Histological examination of the biopsy material reveals cartilaginous lamellae of the disc in varying degrees of necrosis and liquefaction (Fig 1). The inner lamellae of the disc are often necrotic. Dense hyaline cartilage is seen gradually thinning out into fibrous cartilage with reticular dissolution of the tissue around large cartilage cells (Fig 2). Oc

# THE MECHANISM OF THE INTERVERTEBRAL DISC PROTRUSION

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THE concept of sciatica has changed so radically and rapidly in the 15 years since Mixter and Barr's basic contribution to its diagnosis and surgical treatment that pathological anatomy and physiology have been unable to keep up with the clinical development.

Both sciatica and low back pain—the scourge of neurologists and orthopedic surgeons for scores of years—seem to have become a problem for the neurosurgeon. However, growing experience has shown that operative treatment does not benefit, in the long run, more than one-half to two-thirds of the patients in this group. Indeed, the fact that the neurosurgeons have changed their operative approach and technique repeatedly would suggest that they were not wholly satisfied with their results. It is quite confusing to see not only that the success of the same operative method varies widely in the hands of different surgeons but also that a method is sometimes dismissed by the same surgeon who had praised it previously because he found it ineffective in some patients.

It has been suggested that valid statistics of the final results of an operative method will be obtained only if it is performed by the same surgeon with controls for comparison in a sufficient number of patients taken at random. However, this method of sampling will give the expected results only if the basic pathology is uniform and that is exactly what is under scrutiny. If the presumption is made that the mechanism of disc protrusion is not the same in all patients, then it is obvious that one type of treatment will not fit all patients.

Most conjectures concerning the mechanism of the intervertebral disc protrusion are not based on objective experience with the pathological process. A great amount of de-

tailed knowledge has been collected as to the clinical x-ray and operative findings in the disc syndrome but very little is known about the pathological anatomy of the process. A few operative and many diagrammatic sketches have been published indicating what was seen at operation and what the surgeon inferred as to the mechanism of the intervertebral disc disorder. Very few of these concepts were based on histologic-pathological findings. Not even a uniform nomenclature has been generally accepted. The terms hidden or bulging disc, ruptured, herniating protruded, and slipped disc are sometimes used as if interchangeable. In reality they denote entirely different conditions.

Statistics concerning 40 cases of disc removal for sciatica from patients whose clinical, x-ray, operative, and pathological data were complete and who could be followed-up for a sufficient number of years form the basis of Table I. These cases represent part of a group of 169 in which removal was carried out by F. C. Grant and R. A. Goff in the Hospital of the University of Pennsylvania and the Graduate Hospital in Philadelphia respectively between the years 1939 and 1943.

TABLE I.—TYPES OF DISCS OPERATIVELY REMOVED

Type	No.	Per cent	Good or better results		Average result of the whole group
			No.	Per cent	
Bulging	13	37.5	2	15	Fair to poor
Herniating		37.5	9	24	Excellent to good
Slipped	14	35	8	57	Good to fair
Total	40				

Histopathological examination of the 169 discs removed at operation and of 20 controls seems to suggest that the pathological findings may be grouped into three almost equal classes with widely different results.

From the Neuropathological Laboratory of the Neurosurgical Service of the University Hospital and the Department of Neuroanatomy of the Graduate School of Medicine, University of Pennsylvania.



Fig 4



Fig 5

Figs 4 and 5. A, 50 years, 42-146. Fig 4 phosphotungstic acid hematoxylin,  $\times 88$ . Fig 5, van Gieson,  $\times 8$ . Origin, no trauma remembered. Clinically, typical sciatica of 20 years' duration. Operation revealed a large disc over which the nerve was hooked up and freed. Pathologically, the piece removed represents a section of the intervertebral disc (Fig 4). The surface of its bony attachment is only 6 centimeter long but its extension toward the center of the disc is more than 1 centimeter long. It shows clearly from above downward the ragged bony attachment of hyaline cartilage (H) followed by fibrous material but no pulp. The detail (Fig 5) shows patches of brown atrophy (B) and a few strands of connective tissue fibers at its inner margin. Result good.

of cleavage as a rule runs the hyaline cartilage (Fig 8). In either case, the separation from the elastic lamellae are cross and some layer after the other is results from the elasticity of the annulus fibrosus. The most central portions of the disc may (Fig 7) Areas of partial rupture after long and others of granular material are visible in the fibrous part of the disc. Occasionally remnants of cartilage are seen in the nucleus pulposus. In other words, the histological picture is that of a disc transsected vertically and run through the cartilage fibers.

A similar picture is found in that only 57 per cent of the discs in this group had a good result suggests that the surgical technique may be improved.

result suggests that the surgical technique may be improved.

In slightly more than one-third of our cases of disc removal injury led to rupture of the lamellae extending into the epiphyseal plate and to fracture of the rim of the vertebra. This lesion frees the disc from its anchorage and permits it to slip backward. In doing so it encroaches upon a root and extends it. The sharp bony margins may secondarily sever the slipped portion of the disc partially or completely.

#### DISCUSSION

Various questions pertaining to the disc syndrome have been raised. The most puzzling of all is what happened to the victims of sciatica who were not operated upon prior to the last 15 years? True the neurologist saw patients with chronic sciatica. But with our present experience one would expect large numbers of them eventually to enter institutions for the chronically sick. This was definitely not the





Fig. 3 H., 4+ Elastic,  $\times 55$  Origin traumatic. Clinically typical scoliosis. X ray spondylolisthesis. Operation revealed small disc consisting of a small rim of elastic hyaline cartilage surrounding the nucleus pulposus. The nerve was found biconical and freed. Pathologically an advanced granular reticular necrosis (N) of the feathery gelatinous substance surrounding the pulp was found. An unusually large portion of the nucleus pulposus as adherent to the disc. TB picture shows the typical tuft-like structures (T) lined by cartilage cells, some of them in gelatinous degeneration. Result good.

asionally an amorphous mass is found which may represent liquefied cartilage or may constitute part of the nucleus pulposus (Fig. 3). However there is no evidence that the hernia usually consists of nucleus pulposus. In other instances the rent does not go straight inward but obliquely upward severing the attachment of one or more lamellae to the epiphyseal plate (Fig. 4). Pieces of brown atrophy lined by connective tissue are sometimes visible and may indicate the long duration of the process (Fig. 5).

**Result.** Removal of the herniated tissue and freeing of the involved posterior root gave excellent or good results in 83 per cent of those operated upon in this group.

A herniating disc results from traumatic necrosis of the disc lamellae and their protru-

sion through a rent in the annulus fibrosus. Liquefied cartilage or viscous material of the nucleus pulposus may be extruded. The protruded mass has to be excised and the content of the disc eventrated sufficiently to free the overextended posterior root. The good operative results indicate that the surgical procedure was adequate in this group.

### GROUP III

In our third group of patients it was found that an eccentric posterior portion of the disc had actually slipped backward from its attachments to the bony surface of the vertebral bodies. In other words, this type represents a true focal protrusion of the intervertebral disc. It is not easy to explain satisfactorily from the operative appearance of the disc or from gross examination of the specimens the mechanism of slipping. The apparent reason for this is that the surgeon has to cut into the protruding material in order to remove it. The direction of the incision is dictated by the narrow space of exposure rather than the anatomical situation. Only when the slipped portion of the disc was broken off and removed in its entirety was a revealing specimen made available.

Pathological examination shows a picture entirely different from that of the previous group. We find parts of the epiphyseal plate and sometimes of the bone itself (Fig. 6). A group of loosely arranged bone septa is present, sometimes filled with red bone marrow fragments of the posterior longitudinal ligament and cartilaginous lamellae of the disc. The continuity of bone, epiphyseal plate, hyaline, and fibrous cartilage is evident. The tissue may be in degeneration as is to be expected after being separated for quite a while from its normal environment. The fact that this often gives the inner part of the disc a gelatinous appearance but that no tufts or cartilage cells are visible suggests that the tear has been confined to the posterior one-fourth or one-third of the disc.

A similar though less complete pathological picture is found if the protruded disc has not been fractured and the annulus has had to be incised to remove the injured lamellae. Again we find a large portion of the disc with its at-



Fig. 4.



Fig. 5

Figs. 4 and 5. A., 50 years 42-146. Fig. 4, photomicrograph, acid hematoxylin,  $\times 85$ . Fig. 5, van Gieson,  $\times 8$ . Origin, no trauma remembered. Clinically, typical sciatica of 20 years duration. Operation revealed a large disc over which the nerve was hooked up and freed. Pathologically, the piece removed represents a section of the intervertebral disc (Fig. 4). The surface of its bony attachment is only 6 centimeter long, but its extension toward the center of the disc is more than 1 centimeter long. It shows clearly from above downward the ragged bony attachment of hyaline cartilage (H) followed by fibrous material but no pulp. The detail (Fig. 5) shows patches of brown atrophy (B) and a few strands of connective tissue fibers at its inner margin. Result good.

tachment. The line of cleavage as a rule runs smoothly through the hyaline cartilage (Fig. 7) or particles of bone may be found in a ragged line of separation (Fig. 8). In either instance the disc is characterized by its horse-shoe shape which results from the elasticity of its stiff fibers after their separation from the bone. The cartilaginous lamellae are cross-sectioned so that one layer after the other is visible from the rest of the annulus fibrosus on the left to the more central portions of the disc on the right (Fig. 7). Areas of partial necrosis and softening and others of granular degeneration are visible in the fibrous part of the disc. Only occasionally remnants of cartilage cells or other parts of the nucleus pulposus are found. In other words, the histological sections show a radial slice of a disc transecting the lamellae in a vertical sector and running parallel with the cartilage fibers.

Results. The fact that only 57 per cent of those operated upon in this group had a good

result suggests that the surgical technique may be improved.

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Fig. 2. H 48—Elastic,  $\times 85$  Origin traumatic. Clinically typical scoliosis. X-ray spondylolisthesis. Operation revealed a small disc consisting of a small rim of reticular hyaline cartilage surrounding the nucleus pulposus. The nerve as found abnormal and freed. Pathologically an advanced granular reticular necrosis (N) of the feathery gelatinous substance surrounding the pulp was found. An unusually large portion of the nucleus pulposus as adherent to the disc. The picture shows the typical tuft like structures (T) lined by cartilage cells, some of them in gelatinous degeneration. Result good.

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#### GROUP III

In our third group of patients it was found that an eccentric posterior portion of the disc had actually *slipped* backward from its attachments to the bony surface of the vertebral bodies. In other words, this type represents a true focal protrusion of the intervertebral disc. It is not easy to explain satisfactorily from the operative appearance of the disc or from gross examination of the specimens the mechanism of slipping. The apparent reason for this is that the surgeon has to cut into the protruding material in order to remove it. The direction of the incision is dictated by the narrow space of exposure rather than the anatomical situation. Only when the slipped portion of the disc was broken off and removed in its entirety was a revealing specimen made available.

Pathological examination shows a picture entirely different from that of the previous group. We find parts of the epiphyseal plate and sometimes of the bone itself (Fig. 6). A group of loosely arranged bone septa is present, sometimes filled with red bone marrow fragments of the posterior longitudinal ligament and cartilaginous lamellae of the disc. The continuity of bone, epiphyseal plate, hyaline, and fibrous cartilage is evident. The tissue may be in degeneration as is to be expected after being separated for quite a while from its normal environment. The fact that this often gives the inner part of the disc a gelatinous appearance but that no tufts or cartilage cells are visible suggests that the tear has been confined to the posterior one-fourth or one-third of the disc.

A similar though less complete pathological picture is found if the protruded disc has not been fractured and the annulus has had to be incised to remove the injured lamellae. Again we find a large portion of the disc with its at

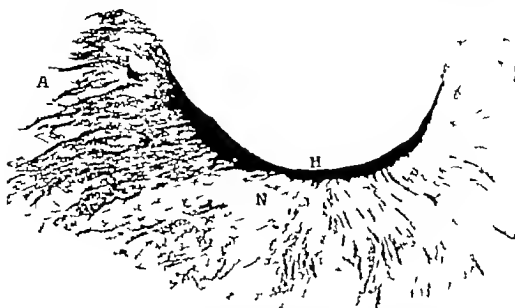


Fig 7. H B 42-91. Elastica, X 6. Origin traumatic. Clinically low back pain no sciatica. X ray epiphyseal rupture. Operation revealed a protruding disc which was removed after incision of the annulus fibrosus. The hooked up nerve was freed. Pathologically the disc showed bony adhesions at the hyaline (H) cartilaginous layer a large fibrous layer with some brown and granular degenerations and necrosis in the transitional area to the central part (N). 4 Annulus fibrosus no pulp. Result excellent.



Fig 8. Mrs B. Th. 60 years, 47-179 van Gieson X 6. Origin unknown. Clinically incomplete sciatica. X ray narrowing of interspace between the fourth and fifth lumbar vertebrae. Slight spondylolisthesis of the fifth lumbar. Myelogram shows a posterior displacement of disc. Operation revealed a horseshoe shaped disc below the fifth lumbar. The dura was incised and a considerable amount of disc material was removed. The disc consisted pathologically of hyaline cartilage with attached bone fragments and fibrous cartilage containing up to 8 large boxed-in cells. No pulp was adherent. Result 2 years later numbness and paresthesia were still present in the left foot. Pain was shooting down the left leg. Lasègue positive. Patient believed to be improved by 80 per cent but this is in contrast to the objective findings.

analogy but it molds our mental image of the anatomical structure of the disc suggesting

that it is a bladder with more or less solid walls and a viscous core containing the resid



Fig. 6. Sister R. 43-4. Elastica,  $\times 8$ . Origin traumatic. Classically typical sciatica. Upper posterior angle of the fifth lumbar vertebra broken off. Operation revealed ruptured disc. The root as hooked up and freed. Pathologically the picture shows the posterior lower angle of the fifth lumbar vertebra broken down a bone lamellae (B). The posterior longitudinal ligament (PL) is adherent to the bone. C is posterior (right) margin, the hyaline and fibrocartilaginous tissue of the intervertebral disc (D) its inferior surface. Only few ring-shaped lamellae of the disc are preserved as dark lines. Most of the tissue shows a hyaline degeneration. Rich becomes slightly gelatinous toward the center of the disc. Result excellent for 3 years until she began tremendous physical work resulting in instability of her back. She was working without complaints while wearing her brace but fusion, as recommended by orthopedists. Went to India for missionary work. Without fusion. Satisfied 7 years later.

case. There is good reason to believe that parts of the protruded disc become separated and resorbed in the course of time. One also wonders how it happens that in a considerable number of husky persons trivial trauma leads to infraction not only of the epiphyseal cartilage but also of the bone. If however this mechanism is operative why is it found in only about one-third of the patients with disc syndrome?

The majority of both neurologists and neurosurgeons agree today that not all cases of

sciatica are caused by a protruding disc or lend themselves equally well to operative treatment. Consideration of the anatomical and pathological findings indicates clearly that sciatic pain—in contrast to the pure low back pain—cannot be blamed on an abnormal disc unless a posterior root is compressed by it. Decompression of the involved root is therefore the first requisite of a successful operation for sciatica. This explains clearly why a simple bulging disc should be left alone.<sup>1</sup> The validity of this statement may be strengthened by the fact that bulging discs were found in necropsy in 28 per cent of 75 persons who at no time had complained of sciatica (Hilowitz).

In considering the postoperative results the patients of this, more than the other two groups, complained of backache rather than true sciatica. Our material is too small for a conclusive estimate but if our impressions were correct the wisdom of removing parts of a normal disc would be further challenged because an already unsatisfactory stability of the spine would be disturbed to a still greater extent. A more rational procedure in this group of patients might be fusion of the spine so highly recommended by orthopedic surgeons, yet not found to be superior to simple disc removal by neurosurgeons.

There can be no doubt that disc material herniating through a rent in the annulus fibrosus needs thorough removal to free the involved posterior root. But again the question arises: What is the rationale from the pathological point of view of scraping out from within the disc all available material or of attempting evacuation of the nucleus pulposus? Finally, why does the annulus fibrosus, surrounding the disc rupture just at its posterior circumference?

These questions cannot be answered with out a true three dimensional concept of the configuration of the normal intervertebral disc together with its attachment to its adjacent vertebrae.

It has been said that the intervertebral disc functions as a water cushion between two vertebrae. This is obviously no more than an

<sup>1</sup>Spurling and Grantzham have recently stressed these points.

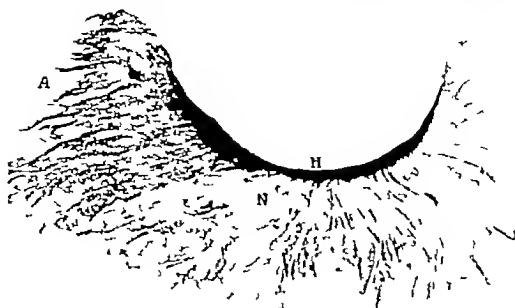


Fig 7 H B 42-91 Flastica, X 9. Origin traumatic. Clinically low back pain no sciatica. \ ray epiphyseal rupture. Operation revealed a protruding disc which was removed after incision of the annulus fibrosus. The hooked-up nerve was freed. Pathologically the disc showed bony adhesions at the hyaline (H) cartilaginous layer a large fibrous layer with some brown and granular degenerations and necrosis in the transitional area to the central part (A). 4 Annulus fibrosus no pulp. Result excellent.



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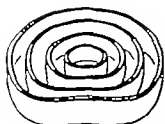


Fig. 9. Diagram of the structure of the disc lamellae.

als of the notochord. Some technical operative recommendations seem to stem from this erroneous concept.

Actually the disc is composed of numerous cylindroid-shaped lamellae arranged around one another in near concentric fashion (Fig. 9). The greater part of these lamellae consists of fibrous cartilage. The lamellae fuse together at their upper and lower ends in a homogeneous plate of hyaline cartilage (Fig. 12). These plates represent simultaneously the upper and lower surfaces of the disc and the epiphyseal plates by means of which the disc is attached to the adjacent vertebrae. The external layers of the lamellae which form the circular wrappings of the disc—the annulus fibrosus—are strongly fibrous and stiff. They do not fuse into the epiphyseal plate but



Fig. 10. L. 43 years, colored, 43-45. Elastic, X63. Origin traumatic. Clinically typical sciatica. X-ray sclerosed aorta. Operation: herniating disc. Pathologically severe reticular trophy of fibrous cartilage with large fibrocartilage cells. This is a progressed state of degeneration, possibly of vasculonutritional origin, characterized by absence of viable cells within the boxes. Some boxes are filled with connective tissue, others are empty. Result seemed good in the beginning but was unsatisfactory 5 years later, probably because of the insufficient blood supply from the sclerosed aorta.

are directly inserted into the bone surface of the vertebrae (Sharpey's fibers).

The central portion of the disc consists of a biconvex lentil-shaped mass—the nucleus pulposus—which is gelatinous in youth and becomes more fibrous in adult life. Peterson describes the nucleus pulposus as true fibrocartilage in an almost fluid interfibrillary substance and Schaffer as chondro-mucoid jelly. Soft fibrous cartilage lining the nucleus pulposus protrudes tuft or feather like into its ragged cavity. Notochord cells are found in its center at birth but disappear after the third year of life. Fick, Saunders, Dockerty and Love have described and illustrated vascular cells in the pulp of adults which they identify with notochord cells. However most anatomists and pathologists agree that no notochord cells survive in adults unless in a true chordoma. The cells seen in the gelatinous part of the disc are surrounded by a halo and arranged in groups of 2 or 4 within a mother capsule (Kodliker). They represent cartilage cells.

Small foci of softening and cavity formation in the fibrous cartilage seem to occur normally. Conversely wear and tear in consequence of strain and age seem to change the disc in the opposite direction. The nucleus pulposus loses its viscous appearance and becomes more fibrous, tendinous, chondroid and eventually calcified (Uebermuth). Rathcke found gross calcification of the nucleus pulposus in 4.1 per cent of spines in patients between the ages of 30 and 50 and 8.7 per cent in the older age group. A powder-like calcium deposit is often seen on the tufts of the nucleus pulposus of older persons. The disc lamellae shrink and seem to be more brittle. Signs of brown atrophy are found. However no indication of disease was observed in our disc biopsies with the three following exceptions. Marked necrosis was present in the discs of 3 middle aged colored men with x-ray evidence of progressive sclerosis of the descending aorta (Fig. 10). They were considered as of vasculonutritional origin. Infection, inflammation and cartilaginous metaplasia as described by Saunders and Imman were absent in our material. Schmorl believes that they are very rare in adults.

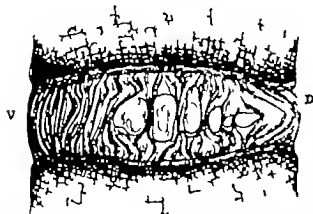


Fig. 11. Cross section of normal disc with separate nucleus pulposus, extending backward to dorsal aspect (D) and adjacent vertebrae. Modified after Boernig.

All authors agree that necroses with liquefaction of cartilage are common in biopsy material (Smith Saunders and Inman) and fairly frequent in necropsy material (Schmorl and Junghans). However there is difference of opinion as to cause and effect. Some believe that the disc ruptures because its lamellae have become necrotic in consequence of disease others see in the necrotic tissue the effect of trauma. Hence the first group is in favor of thorough surgical dismemberment of the disc to prevent further expulsion of diseased lamellae. Some are of the opinion that the extruded liquefied tissue is necessarily part of the nucleus pulposus. They speak of protrusion of the nucleus pulposus and go so far as to attempt scooping out of the entire central part of the disc. In our own biopsy material of herniating discs tufts capsule cells or other characteristics of the nucleus pulposus were usually absent in the removed amorphous viscous material.

The position of the nucleus pulposus within the normal disc plays a major role in the theories of the protruding disc. Luschka described as a normal variant of the nucleus pulposus a posterior recessus which would bring the gelatinous mass close to the annulus fibrosus. However Schmorl saw Luschka's posterior recessus in only 15 per cent of 400 normal spines although segmentation of the pulp and even 2 or 3 independent gelatinous masses occurred in 75 per cent of 95 normal discs (Fig. 11 Boernig). Horwitz found unilateral posterior dislocation of the nucleus pulposus in 52 per cent of 75 normal discs.

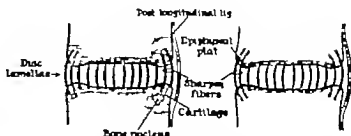


Fig. 12. Diagrammatic picture of anchorage of disc lamellae in epiphyseal plate. Bone dotted cartilage horizontally dashed. The left picture is of a juvenile individual in whom the expanded rim of the vertebrae is still cartilaginous and contains the ring shaped bone nucleus. The Sharpey fibers of the annulus fibrosus are inserted deeply in the cartilaginous rim. The right picture shows the situation in the adult. The expanded rim of the vertebrae is ossified. Sharpey's fibers persist in the bone whereas the disc lamellae remain anchored to the small, permanently cartilaginous epiphyseal plates. Modified after Schmorl.

Schmorl whose opinion is based on the investigation of 8 000 spines summed up his experience in 1930. As I become more familiar with the discs and their pathological changes I am more and more convinced that their tissue is most delicate and vulnerable. It is frequently damaged by strain almost within the range of normal movements or by minor external force. Anatomical studies indicate furthermore that the annulus fibrosus is less dense posteriorly than anteriorly and laterally and finally that the disc itself is less firmly fixed in the bone at the posterior circumference of the



Fig. 13. Sagittal section of normal intervertebral disc showing the adjacent vertebrae with the incomplete ossification of their rims. a Longitudinal ligament b fibrous cartilage c hyaline cartilage d bone lamellae (after Petersen).





Fig. 14. Left: H. K., 30 years. Clinically: pain in the right back radiating down the right leg for 5 months. Potter back. Lastyrow on right. Bilateral absence of Achilles reflex: traumatic origin. X-ray: narrowing of fifth lumbar interspace: tipping of bodies between the fourth and fifth lumbar vertebrae. Rupture of posterior lower epiphyseal rim of the fifth lumbar. Fifth lumbar, 7 to 8 millimeters. Spondylolisthesis of fifth lumbar. Myelogram filling defect between the fourth and fifth lumbar vertebrae on the right. Operation: a loose cartilage, as found, not removed. Pathologically: this appeared to be ruptured fibrocartilaginous disc consisting of part of the annulus fibrosus. The threat is very of straight and loose lamellae. Result: excellent.

Fig. 15. R., 60 years. Clinically: traumatic origin. Incomplete spondylolisthesis. X-ray: narrowing of the fourth lumbar interspace. Chip outside. Collapse of upper posterior angle of the fifth lumbar. Fifth epiphyseal fracture. Wedging of the fifth lumbar to the degree that the posterior half of the fifth lumbar is only about three-fourths as thick as is anterior half. Fifth lumbar, 10 to 12 millimeters. Calcification of orsa. Operation showed: herniating disc. The annulus fibrosus was broken and the disc extruded out. The nerves were freed. Histologically: this is an old preserved disc with complete layers of hyaline and fibrous cartilage. The latter minor reticular rarefaction. Result: good. Check-up 5 years after operation: X-ray subject, complaisant. Patient is satisfied.

vertebra. If we combine these considerations with the normal architecture of the disc lamellae it is easily understood that mild torque of the spine may lead to rupture of lamellae of the disc with subsequent necrosis and possible liquefaction. The debris may be pressed through a dehiscence of the annulus fibrosus. This mechanism explains why portions of the annulus are comparatively rarely found in the biopsy material and that the torn annulus often tends to fall back in place as soon as the nuclear part of the protrusion is removed (Bradford and Spurling). One may wonder under these conditions whether excision of more of the annulus and disc lamellae than is traumatized and necrotic anyway will be of help to the patient. Certainly not much can be expected in this instance from packing the cavity with bone chips since there is no free

bone surface to which they may become attached. Finally, no good reason for fusion of the spine can be seen in the group of the herniating disc since the results of its simple removal are very satisfactory.

One third of our patients with disc syndrome had sustained a fracture of the epiphyseal plate with or without a chip fracture of the adjacent vertebral body. This is an extraordinary experience in a group of healthy individuals undergoing sometimes so mild an injury that it is difficult to remember it. The explanation may be seen in the normal development of the surface of the vertebral body. In the early years of life the upper and lower expansions of the vertebrae are not ossified. A cap of cartilage is glued over them. Its inner surface represents the permanent epiphyseal plate while its sides cover the still re-

cessed rim in a circular fashion (Fig 12) A ring shaped bone nucleus embedded within the cartilage builds eventually the bony expansions of the vertebral surfaces. However this process may remain incomplete in otherwise normal persons. Large and small cavities are extant between flimsy bony septa (Fig 13) Hence this part of the vertebra is most endangered by brusque changes in position of the spine. It is true the disc is protected by the longitudinal ligaments but the posterior ligament is not attached to the vertebra proper and only loosely to the annulus fibrosus. Thus in addition to the universal greater vulnerability of the posterior aspect of the disc an individual constitutional factor has to be considered namely the insufficient ossification of the vertebral rim.

Were the protrusion of the disc symmetrical its attachments had to be broken off both at the superior and inferior epiphyseal plates all around the posterior circumference and at least in part at the lateral surfaces. I have not seen a histological specimen containing the two opposite epiphyseal plates and I have not heard that a surgeon has described the protrusion of a disc all around the posterior circumference. The histological picture speaks in favor of a vertical or oblique infraction of the epiphyseal plate and the posterior angle of the bony rim with loosening of a comparatively small sector rather than a horizontal fracture with expulsion of a large posterior semilunar section of the disc. Such an eccentric detachment and protrusion of the disc easily overtaxes the elasticity of the fibrous cartilage. Its fibers rupture or become useless for the stability of the disc.

The annulus fibrosus appears to be often intact primarily and to be torn secondarily by the impact of the sharp margins of the fractured bone. Hence the situation seems to be the reverse of what happens in the herniated disc. Here lamellae and annulus are torn primarily and disc material becomes extruded there the disc material becomes necrotic after fracture of the epiphyseal plate and subsequent overextension of disc fibers. This may or may not be followed by rupture of annulus fibrosus.

These pathological findings suggest the usefulness of a more radical surgical procedure

It may be advisable to remove not only the broken-off fragments of bone and cartilage but to smooth down the remaining sharp bone spicules and to scrape out semidetached particles from the intervertebral space. This is the only condition in which filling of the cavity with bone chips seems reasonable since here is a freshened bone surface to which it may become attached.

If the disc has slipped without rupture of the annulus fibrosus in other words, if the surgeon has to incise the annulus in order to remove the fragments it may be difficult to decide during operation which type of injury is present. The collapse of the upper or lower posterior angle of the vertebral body or fracture of the epiphyseal plate may be evident in the x ray picture so that the surgeon is prepared for what to expect in operation. Lateral various oblique views and stereoscopic pictures may be necessary to visualize the damage in some instances (Fig 14). Wedging of the whole vertebra reducing the posterior part of the fifth lumbar to only three-quarters of its anterior half (17 mm to 21 mm) is apparent in others (Fig 15).

I have confined myself in this paper to a description of the pathological changes of the intervertebral disc and its bony attachment in the sciatic syndrome. However it may be expected that the elastic ligaments which contribute to the stabilization of the spine would become involved by a trauma or in disease independently of the disc which condition would lead to temporary or permanent impingement upon a posterior root. Elsberg, Spurling, Mayfield and Rogers, Craig and Walsh, Dockerty and Love have pointed to this possibility. This material will be discussed separately since its surgical implications differ from those here described.

#### SUMMARY

1. Anatomical and pathological investigations of 169 discs removed in operation and 20 controls indicate that the mechanism of the intervertebral disc protrusion is not uniform.

2. Three conditions are described which differ widely in their mechanism and their surgical prognosis. They are

a. The bulging disc without a rent in the annulus fibrosus and without detachment of



Fig. 14. left. H. K. 3035. Clinically pain in the right back radiating down the right leg for 5 months. Poker back, Lasegue on right, bilateral absence of Achilles reflex, traumatic origin. X-ray. Narrowing of fifth lumbar interspace, flipping of bodies between the fourth and fifth lumbar vertebrae. Rupture of posterior lower epiphyseal rim of the fifth lumbar. Fifth lumbar, 7 to 5 millimeters. Spondylolisthesis of fifth lumbar. Myelogram filling defect between the fourth and fifth lumbar vertebrae on the right. Operation. loose cartilage as found and removed. Pathologically this appeared to be ruptured fibrocartilaginous disc consisting of part of the annulus fibrosus with fibrous layers of straight and loose lamellae. Result, excellent.

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#### SUMMARY

1 Anatomical and pathological investigations of 169 discs removed in operation and 20 controls indicate that the mechanism of the intervertebral disc protrusion is not uniform

2 Three conditions are described which differ widely in their mechanism and their surgical prognosis They are

a The bulging disc without a rent in the annulus fibrosus and without detachment of

the disc from the bone. Material removed by incision of the disc revealed normal cartilage lamellae.

b The herniated disc. Traumatized disc lamellae necrotic or liquefied are protruded through a rent of the annulus fibrosus into the spinal cavity where they may encroach upon and overextend a posterior root. Herniation of the nucleus pulposus is the exception rather than the rule.

c The slipped disc in which the trauma involves the cartilaginous epiphyseal plate and which is sometimes accompanied by a chip fracture of the vertebral rim. This frees the disc from its anchorage and permits an eccentric portion of its posterior circumference to slip backward. A posterior root may become hooked up over the protrusion. The sharp bony edges of the fracture may secondarily rupture the slipped disc. It is explained that an individual constitutional disposition may be responsible for this type of lesion. This condition is visible in the x ray picture.

3 No indication of primary disease of the disc could be detected. Trauma appears to be the only cause of herniation or slippage of the disc.

4 The results of incision and dismemberment of a bulging disc are so poor as to suggest that in the 66 per cent of these patients not benefited by operation the bulging disc was not the cause of the sciatic syndrome. The inference is that the bulging disc should not be removed unless it clearly involves a root.

5 The results of simple removal of the herniated disc are so satisfactory that there seems to be no need for further improvement of the operative technique.

6 Operation on the slipped disc gives good to fair results in about one-half of the persons

operated upon which fact suggests that there is still room for improvement.

7 The question is discussed under which conditions thorough evagination of the disc may be indicated and when filling of the intervertebral space with bone chips or spinal fusion may be useful.

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# REPAIR OF INGUINAL HERNIA WITH EXTERNAL OBLIQUE FASCIA

## Critical Evaluation of Results

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INGUINAL hernia and measures for the correction of this anatomic abnormality have long attracted the interest of surgeons of all countries as evidenced by the voluminous literature on this subject and the many methods of treatment that have been used. It has been widely accepted that an indirect inguinal hernia can be repaired accurately and that a satisfactory result will be obtained. The cardinal features of such repair are high ligation of the hernial sac and reinforcement of both the external and internal inguinal rings. The importance of several other factors has been stressed repeatedly. These factors include intelligent preoperative preparation of the patient as a whole and of the skin of the groin in particular; safe and satisfactory anesthesia; adequate exposure of the structures of the inguinal canal; meticulously complete hemostasis; careful aseptic technique; and accurate apposition of fascia to fascia without tension. It might be thought that attention to these details would lead to permanent correction of the hernia in every case.

### RECURRENCE OF HERNIA AFTER HERNIORRHAPHY

On consideration of the incidence of recurrence of hernia after herniorrhaphy as reported in the literature, one is forced to conclude that there is no perfect surgeon and no perfect surgical procedure. Although many surgeons have gained wide experience in the surgical repair of hernias, when the results of treatment have been carefully tabulated and analyzed in the various medical journals, the recurrence rates remain too high. Attention has long been directed to measures which might improve these results.

A review of the literature indicates that many causes for surgical failure have been advanced. Although Marcy Halsted, McArthur and others who wrote a half century ago when herniorrhaphy was first established anatomically as a satisfactory procedure found that wound infection was the most important etiologic factor in the recurrence of a hernia, sepsis has rarely been incriminated as a major factor in recent years. Bloodgood estimated that 5 per cent of men have a weak or obliterated conjoint tendon which can be detected by physical examination. He found that the hernias occurred after herniorrhaphy in 50 per cent of cases in which the conjoint tendon was of this type. This anatomic aspect of the problem has been clarified by Anson and McVay (1, 10) who found that in 97 per cent of cases there is a red muscle border at the lateral free margin of the internal oblique muscle which is unsuited for fascia-to-fascia suture to pelvic ligaments and that the tendon of the transversus abdominis muscle (usually tendinous in its lower lateral portion) is inserted into Cooper's ligament on the superior pubic ramus. They further pointed out that reuniting the transversalis fascia—that is, the fascia or tendon of the transversus abdominis muscle—to Cooper's ligament also can be used to repair a femoral hernia or to prevent the development of such a hernia. Burton has reviewed the clinical application of these anatomic findings.

Many surgeons have found that the incidence of recurrent hernia is likely to be high if the original hernia has been present for a long time and if the patient has poor anatomic structures that is, weak or deficient fascial layers. This is particularly true if the hernial sac is large or if the hernia has extended into the scrotum. In cases in which a truss has

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the disc from the bone. Material removed by incision of the disc revealed normal cartilage lamellae.

b The herniated disc. Traumatized disc lamellae necrotic or liquefied are protruded through a rent of the annulus fibrosus into the spinal cavity where they may encroach upon and overextend a posterior root. Herniation of the nucleus pulposus is the exception rather than the rule.

c The slipped disc in which the trauma involves the cartilaginous epiphyseal plate and which is sometimes accompanied by a chip fracture of the vertebral rim. This frees the disc from its anchorage and permits an eccentric portion of its posterior circumference to slip backward. A posterior root may become hooked up over the protrusion. The sharp bony edges of the fracture may secondarily rupture the slipped disc. It is explained that an individual constitutional disposition may be responsible for this type of lesion. This condition is visible in the x ray picture.

3 No indication of primary disease of the disc could be detected. Trauma appears to be the only cause of herniation or slipping of the disc.

4 The results of incision and dismemberment of a bulging disc are so poor as to suggest that in the 66 per cent of these patients not benefited by operation the bulging disc was not the cause of the sciatic syndrome. The inference is that the bulging disc should not be removed unless it clearly involves a root.

5 The results of simple removal of the herniated disc are so satisfactory that there seems to be no need for further improvement of the operative technique.

6 Operation on the slipped disc gives good to fair results in about one half of the persons

operated upon which fact suggests that there is still room for improvement.

The question is discussed under which conditions thorough eventration of the disc may be indicated and when filling of the intervertebral space with bone chips or spinal fusion may be useful.

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least 5 years have elapsed since the operation. A review of the literature has failed to reveal any report of a large series of cases of hernia in which the patients have been observed thus long after herniorrhaphy has been performed.

#### THE MCARTHUR OPERATION

In 1901 McArthur described a technique for the surgical repair of inguinal hernia by utilizing strips of external oblique fascia as suture material. He pointed out that the permanence of such a repair does not depend on foreign suture material and on apposition of scar tissue but on a lacing of the structures of the inguinal canal with living fascial sutures. A strip of fascia about 4 to 6 inches (10 to 15 cm) long and about  $\frac{1}{8}$  to  $\frac{1}{4}$  inch (0.5 cm) wide is obtained from the medial border of the external oblique fascia. This strip of fascia should not be separated from its attachment to the pubic tubercle. It is used to fasten the conjoint tendon to the inguinal ligament (Poupart's ligament) in order to obliterate the inguinal canal. In cases in which there is considerable relaxation of the tissues a similar strip of fascia obtained from the lateral border of the external oblique muscle may be used.

By means of animal investigation McArthur demonstrated that living fascial sutures that is fascial sutures that are left attached to the pubic tubercle as previously described will survive for months or years. This observation was confirmed by postmortem examination of human beings who had undergone herniorrhaphy in which living fascial sutures had been employed.

At present there is no operation that can be used satisfactorily in all cases of inguinal hernia. An ideal operation would be one that would be followed by a smooth convalescence, satisfactory healing of the incision and a low incidence of recurrence. The McArthur type of herniorrhaphy appears to meet these requirements as well as does any other type of operation.

#### MATERIAL

In a period of 12½ years from July 1, 1931 to December 31, 1942 inclusive one of us (C.W.M.) operated on 332 patients for inguinal hernia. In the early part of this period

TABLE I — TYPE OF UNILATERAL HERNIA FOUND AT OPERATION IN 168 CASES

Side of involvement	Type of hernia			Total
	Indirect	Direct	Double sac	
Left	44	8	0	52
Right	36	4	7	47
Total	80	12	7	99

of fascia and catgut were used as suture material in 102 cases. Nylon sutures were used in 8 cases. A modification of McArthur's herniorrhaphy was used in the 222 remaining cases which form the basis of this report. The ages of the patients ranged from 11 to 73 years and the average age was 47 years. Five of the patients were women and the remainder were males. The occupation of the patients varied widely.

The hernia was classified as a recurrent hernia in 5 of the 222 cases. In 1 of the 5 cases a hernia had recurred in each groin. The primary hernias were unilateral in 168 cases and bilateral in 49 cases. Table I shows the side of involvement and the type of unilateral hernia encountered in the 168 cases. Bilateral herniorrhaphy was performed in 38 of the 49 cases in which a primary hernia was present in each groin.

#### SURGICAL TREATMENT

In all of the 222 cases the patients were anesthetized with nitrous oxide-oxygen and ether. As previously stated a modification of McArthur's herniorrhaphy was performed in all of these cases. This operative procedure has been used for many years by different surgeons. The technique is briefly as follows.

An incision about 4 inches (10 cm) long is made nearly parallel to and about  $\frac{1}{2}$  inch (1 cm) above the inguinal ligament (Poupart's ligament). The fascia of the external oblique muscle is divided in the direction of its fibers. The skin is retracted superolaterally to the upper limit of the tendinous portion of the external oblique muscle. A pedicled suture is obtained from the medial border of the external oblique muscle just as it is in the McArthur operation. The fascial suture which still is attached to the pubic tubercle



been worn for a long time the pressure exerted by the truss has been said to have caused thinning and devitalization of the inguinal tissues (8). The increasing incidence of recurrent hernia among persons of advanced age has been noted by many surgeons.

The choice of suture material has been a matter of considerable controversy. Kangaroo tendon and ox fascia have largely been replaced by catgut in herniorrhaphy. In a study of a series of cases in which the patients were followed for from 1 to 10 years after herniorrhaphy was performed Parsons found that the hernia recurred in 3.5 per cent of the cases in which silk was used as the suture material and in 12.7 per cent of the cases in which catgut was used. In other words, in the cases in which catgut was used the incidence of recurrent hernia was approximately four times as great as it was in the cases in which silk was used. Cotton, silver and steel wire have their advocates. Many surgeons have strongly urged the use of the types of fascial sutures employed by McArthur and Gallie respectively. It has been suggested that if fascial sutures are an added safeguard in cases of large hernias hernias that are difficult to repair or recurrent hernias, they should be employed in all cases of hernia in order to reinforce the repaired anatomic structures.

Fallis, Zimmerman and other authors have concluded that the choice of the operative procedure in a given case is of minor importance as compared with the selection of the surgeon. Patrick in an investigation of the causes of recurrence of hernia in the British Army found that in 63 per cent of the cases of recurrent hernia the hernial sac had not been treated adequately at the time of operation. Fallis has stated that all hernias can be repaired and that all recurrences, therefore, are the result of technical error. It is the surgeon's responsibility not only to avoid errors in technique but also to fit the surgical procedure to the individual patient.

The site of recurrence is a matter on which there is not general agreement. Whether all herniations developing after an attempt at repair of a hernia previously present in the same area should be considered to be recurrent hernias rather than primary hernias is a moot

question. Most statistical studies indicate that 75 per cent of primary inguinal hernias in males are indirect and that the remaining 25 per cent are direct in type. The great majority (about 90 per cent) of hernias which occur after repair of indirect or direct inguinal hernias are direct in type and occur low in the operative scar. A recurrence in the vicinity of the internal ring is probably to be interpreted as a technical failure at high ligation and fascial approximation about the cord at the upper end of the inguinal canal. Of special significance in this connection is the report by Grace and Johnson of a follow up study in 1,032 cases in which operation for hernia had been performed on patients who were more than 50 years of age. In at least 50 per cent of the cases in which the hernia recurred after the operation the patients were unaware of the recurrence. This finding should be considered in comparing the results reported by different surgeons. For statistical purposes, any hernia which appears in the same groin at any time after a herniorrhaphy must be classified as a recurrent hernia.

The time that may elapse between a herniorrhaphy and the recurrence of a hernia has not been determined definitely. In many of the cases reported in the literature, the patients have been followed for only 1 or 2 years. Statistics based on cases in which the patients have been followed for this period of time suggest that 70 to 80 per cent of recurrent hernias appear in the first year after the operation. Bloch reviewed the results obtained in a large series of cases in which operations had been performed in German clinics. He estimated that 34.8 per cent of recurrent hernias do not appear until 2 years after the operation. Burdick, Gillespie and Higinbotham found that 113 or approximately 40 per cent of 284 recurrent hernias did not become evident until more than 2 years after herniorrhaphy.

Obviously an analysis based on the observation of patients for 1 or 2 years after herniorrhaphy has been performed will fail to indicate the incidence of recurrent hernia. It is our opinion that in cases of hernia, as in cases of malignant lesions, the results of surgical treatment cannot be evaluated until at

least 5 years have elapsed since the operation. A review of the literature has failed to reveal any report of a large series of cases of hernia in which the patients have been observed this long after herniorrhaphy has been performed.

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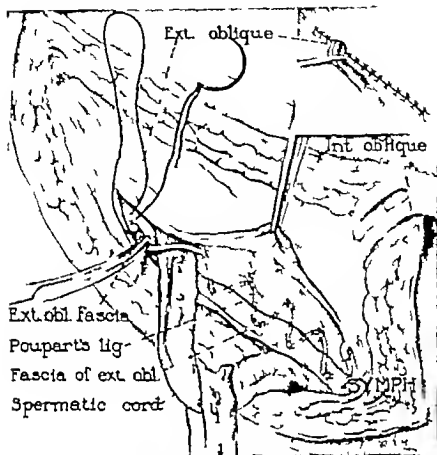


Fig. 2. Technique of herniorrhaphy (modified from McArthur).

is protected with a sponge that has been moistened with a warm isotonic solution of sodium chloride.

The hernial sac then is ligated as high as possible. If the hernia is of the direct type, the hernial sac need not be excised. Instead it can be infolded satisfactorily with pursestring sutures. The free end of the fascial suture is threaded through a Gallie needle and is used to fasten the conjoined tendon to the shelving edge of the inguinal ligament so as to obliterate the inguinal canal. Although the inferior portion of the free margin of the internal oblique muscle frequently is composed of red muscle fibers, a considerable amount of fascia usually can be found superiorly. This fascia is approximated to the inguinal ligament by rolling the border of the muscle posteriorly. The first stitch that is taken with the fascial suture should penetrate the periosteum of the

pubis (Fig. 1) in order to prevent bulging in the lower end of the incision. The external oblique fascia is closed beneath the spermatic cord with interrupted cotton sutures so as to make a new subcutaneous inguinal ring (external abdominal ring) superficial to the abdominal inguinal ring (internal abdominal ring). The skin is closed over the structures of the spermatic cord.

If the patient is a male a suspensory bandage is applied before he leaves the operating room. The patients routinely are permitted to get out of bed in from 2 to 4 days after the operation and they generally are dismissed from the hospital before the twelfth postoperative day. At the time of their dismissal the patients are warned that the hernia is likely to recur if they do any excessive straining within 6 months. They also are advised to do everything possible to prevent the development of

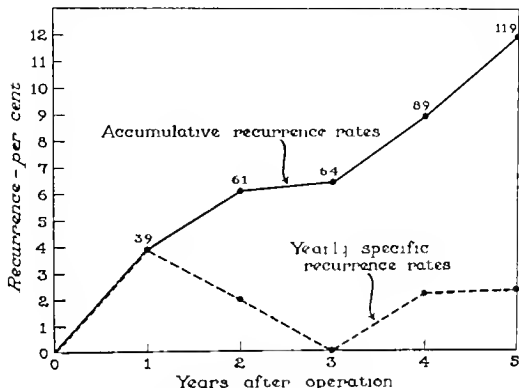


Fig. 2. Incidence and time of appearance of recurrent inguinal hernias.

infection of the respiratory tract and the attendant coughing and sneezing

#### RESULTS

Follow up data were obtained in 208 (94 per cent) of the 222 cases. Since a large proportion of the patients lived a considerable distance from the clinic the follow up data were obtained by sending a questionnaire to all the patients who survived the operation. In 2 of the 168 cases in which the hernias were unilateral the patients died in the hospital within 2 weeks after the operation. In these 2 cases the patients were men who were 52 and 64 years of age respectively. In each case necropsy revealed that death was due to pulmonary embolism. Follow up data were obtained in 155 of the 166 remaining cases.

The incidence of recurrent hernia in this group of 155 cases is shown in Table II. The incidence of recurrence and the time that elapsed between the herniorrhaphy and the appearance of the recurrent hernia are shown graphically in Figure 2. The graph refutes the widely held opinion that recurrent hernias usually appear within the first year or two after herniorrhaphy has been performed. It will be noted that the rate of recurrence was

3.9 per cent in the first year after operation was performed. It is our opinion that the true rate of recurrence cannot be determined until 5 years have elapsed. In this series of cases, the correct rate of recurrence was not 3.9 per cent but 11.9 per cent (Table II).

In 32 cases in which follow up data failed to reveal any evidence of recurrence of hernia within the first 5 years after operation similar data also were obtained after 10 or more years had elapsed. In this subsequent period of 5 or more years a recurrent hernia appeared in only 1 of the 32 cases. In this case, the patient was a man who was 54 years of age when the herniorrhaphy was performed. Although

TABLE II — INCIDENCE OF RECURRENCE OF UNILATERAL INGUINAL HERNIA

Years after operation	Cases	Recurrences	
		Number	Per cent
0-1	33	6	3.9
0-2	48	9	6
0-3	4	9	6.4
0-4	35		8.9
0-5	5	4	9

Excluding as of January, 1917. Table includes only cases in which patients were traced for the specified period.

the result appeared to be satisfactory when the patient was examined 9 months after the operation bulging appeared in the inguinal region 10 years later. The information obtained by this follow up study of 32 patients for an additional period of 5 years indicates that 5 years may be considered an adequate period of observation.

Bilateral inguinal hernias were present in 49 of the 222 cases. In 38 of the 49 cases herniorrhaphy was performed on both sides simultaneously. One of the patients, a man aged 58 years, died of pulmonary embolism on the sixth postoperative day. Follow up data were obtained in 34 of the 37 remaining cases. In these 34 cases the recurrence rate was 13 per cent in 5 years. This figure includes every recurrence in this group regardless of whether the recurrence was unilateral or bilateral. Statistically this result appears to have been better than might have been expected in view of the recurrence rate of 11.9 per cent in the cases of unilateral hernia. In 11 of the 49 cases in which bilateral hernias were present herniorrhaphy was performed on one side only.

Operation was performed for a recurrent inguinal hernia in 4 of the 222 cases. In these cases the results were recorded as satisfactory 9 months, 5 years, 8 years and 11 years, respectively after the operations were performed. Previous herniorrhaphy seldom distorts the tissues sufficiently to make the subsequent performance of a McArthur type of herniorrhaphy inadvisable.

In the cases in which the patients had worn a truss before the operation was performed the rate of recurrence was three or four times as great as it was in the cases in which a truss had not been worn. This finding confirms the widely held opinion that special consideration should be given to adequate reinforcement of the inguinal ring in cases in which a truss has been worn. We also found that there was a general correlation between the rate of recurrence and the length of time that a truss had been worn.

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We believe that the end results of herniorrhaphy cannot be evaluated accurately until 5 years have elapsed since the operation. It is our opinion that the reporting of end results observed within a shorter period is an inaccurate and misleading practice which should be abandoned.

Although one surgical procedure should not be used routinely in the repair of inguinal hernia, we have found that the use of external oblique fascia by a modification of McArthur's technique is superior to any other method that we have used.

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# SURGICAL TREATMENT OF RADIATION BURNS

JAMES BARRETT BROWN, M.D., F.A.C.S., FRANK McDOWELL, M.D., F.A.C.S. and  
MINOT P. FRYER, M.D., St. Louis, Missouri

EXCESSIVE exposure to x rays produces changes in the skin and other tissues that sometimes require excision and repair. Radium and other radioactive substances also may cause severe changes. Atomic warfare may produce lesions similar to those seen in local areas at present. The skins of some individuals may be unusually sensitive to the x ray and exposure may produce acute episodes that may clear up in time. Permanent chronic changes however develop in practically all skins which have been exposed to heavy or repeated excessive or incorrect dosages of x rays.

These comments have no relation to the usefulness or indications for x ray therapy, nor are they meant to suggest any directional approach to the problems in the use of radiation therapy.

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Burned hands of physicians are the most frequently seen at the present time (Fig. 2). Many of these burns occur while difficult fractures are being reduced under the fluoroscope. The physician's anxiety for the welfare of his patient may have dulled his regard for his own personal safety. Nevertheless such burns are preventable and every physician using an x ray machine should be aware of the effects of a single large dose and of the irreversible cumulative effect of repeated small doses over many years.

The list of early workers in radiation who have been burned is long and contains many names well known to the profession. Dr. Walter Cannon, late professor of physiology at Harvard, suffered burns of his hands that required excision and grafting. His burns resulted from exposure while doing pioneer work in his x ray studies of the gastrointestinal system before the late effects on the skin were known.

*Dentist's fingers* are sometimes burned (Fig. 3) especially if they hold films in the mouths of patients during exposure.

*Prolonged fluoroscopic examinations* have produced some most unfortunate burns as a result of miscalculations in distance, time or filters (Figs. 1, 5, 15, 16, 20, 21). Examinations of empyema fluid levels, fractured metatarsals and fractured vertebrae have produced especially bad burns. As these burns are of such great trouble both to the patient and to the one responsible for them, it seems advisable to give warning of this source.

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*Commercial epilation of superfluous hair* by x ray has caused some of the most dramatic extensive and useless burns (Figs. 5, 17, 18). Patients have been seen with burns of the entire lower legs, the outside of the thighs, the axillae, outside of upper arms, entire forearms, hands, back of neck, entire face and entire front of neck. The prolonged morbidity, suffering and loss of economic and social status endured by these patients cannot be condoned in the face of the slightness of their original complaint of superfluous hair. This commercial procedure cannot be too severely condemned.

*Hemangioma and plantar warts*. As more time elapses the distant effects of radiation treatment will become more apparent and perhaps in some instances changes in therapy



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Burned hands of physicians are the most frequently seen at the present time (Fig. 2). Many of these burns occur while difficult fractures are being reduced under the fluoroscope; the physician's anxiety for the welfare of his patient may have dulled his regard for his own personal safety. Nevertheless, such burns are preventable and every physician using an x ray machine should be aware of the effects of a single large dose and of the irreversible cumulative effect of repeated small doses over many years.

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*Hemangioma and plantar warts*. As more time elapses the distant effects of radiation treatment will become more apparent and perhaps in some instances changes in therapy

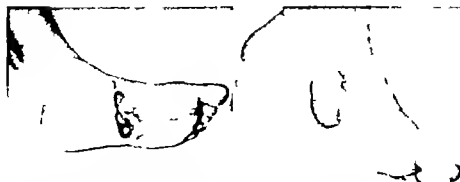


Fig. 6. Sole of foot burn extending so deep that cross leg flap had to be used, rather than free graft. Two operations.

differentiated is sailor's or farmer's skin which is similar but is caused by the cumulative effect of decades of overexposure to sun light in persons who do not form sufficient melanin to protect themselves (in other words, they do not tan). Differentiation can be made by the history and by the fact that sailor's skin symmetrically affects both forearms, both hands, and the entire face and neck in most patients. Telangiectasis is often predominant in x-ray burns, whereas atrophy and keratosis predominate in sailor's skin.

Coal spots rarely occur except in association with x-ray burns. Carcinoma may develop in either.

The progress of a severe chronic x-ray burn through the stages of atrophy telangiectasis,

coal spots, keratosis, and carcinoma is irreversible and inevitable if the patient lives long enough. This course is not affected by the use of any drugs or other means of treatment known at present except the surgical excision and repair of the area. The stages may overlap and the speed of the progress varies greatly so that it is often a major problem to decide when and if to undertake excision. Fast progress in any patient and even slow progress in a young individual are indications for treatment. A paradox of treatment



Fig. 17. Commercial x-ray treatment for removal resulting in almost total burns of lower legs.

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Fig. 1. Fluoroscopic burn following exposure to locate foreign body. Complete early resection with immediate repair with split graft. One operation, normal function.

or dosage will be instituted. Typical lesions that are treated early and in which later dermatitis and chronic atrophy may result are hemangiomas especially about the face (Figs.

9, 10) and plantar warts. Radiation lesions of the sole of the foot are especially difficult to treat even cross-leg flaps may be necessary for repair (Figs. 15, 16).

Fig. 2. Fluoroscopic burn of doctor a, b. Acute burns on both hands—left worse than right. Patient required six grains of morphine a day. Patient came in with consideration of amputation of hand. c, d, Result of general protective care and early resection and free grafting. Recovery was such that he was able to follow full career in anesthesia whereas he formerly was a surgeon.

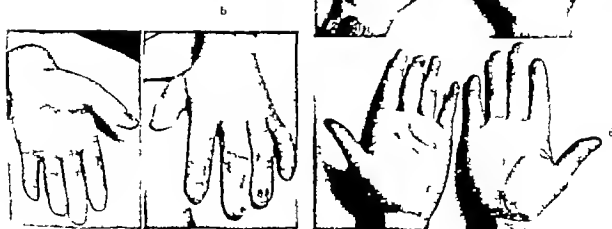


Fig. 2.

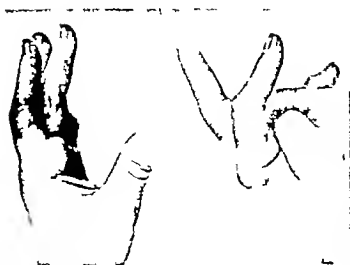


Fig. 3. Dentist's burns. Typical burn of dentist's fingers from holding films in patients' mouths. Resection with immediate split graft. One operation.

It is hoped that none of these statements will be interpreted as underestimating the very great value of radiation therapy and x ray examination for many conditions. The x ray is invaluable and indispensable. Recognition and elimination of the unfortunate ultimate results here discussed may lead to eventual wider usefulness of the various radiation procedures.

#### PATHOGENESIS

Wolbach reported the essential pathological processes which include

- '1. Loss of appendages of the skin
- '2. Replacement of normal collagen by a peculiar dense hyaline collagen rich in elastic fibers and poor in cells
- '3. Obliterative processes in blood vessels of the corium and subcutaneous tissues.
- '4. Necroses of varying sizes in the corium immediately beneath the epidermis. In the earlier stages these are usually in the region of thrombosed telangiectases. In the later stages telangiectasis may be nearly entirely absent.
- '5. In response to necroses of the corium reparative proliferation on the part of the epidermis which may extend beneath the telangiectases or areas of necrosis. "These small necroses containing the thrombosed telangiectases become completely separated from the skin by the layer of regenerated epithelium and persist for a time as dry, dark-colored spots—the coal spots—until cast off. The significance of these processes lies in the fact

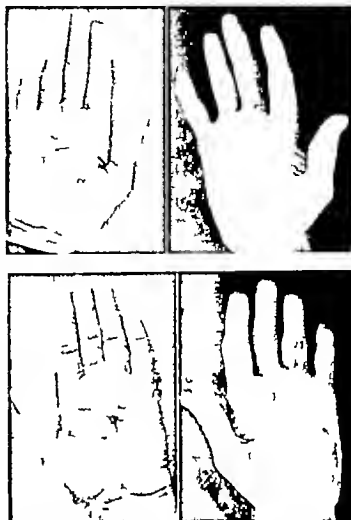


Fig. 4. Eczema burn. Wide deep burns of both hands from treatment for eczema. Repair by resection and replacement of most of the skin of both palmar surfaces including fingers. Two operations were necessary. Function was about normal. To have additional work on fingers of right hand.

that they are invariably present in chronic x ray dermatosis even after the lapse of many months or several years since the last exposure to radiation. Malignant properties may be acquired after years of excessive downward proliferation that is called forth by the changes which take place in the corium and subcutaneous tissues.

The blood vessel changes may be of extreme importance. Early there is a marked thickening of the walls of the arterioles and venules at the junction of the dermis and subcutaneous fat (Fig. 6a). The occlusive endophlebitis seems often to be more severe than the endarteritis resulting in back pressure on the subepithelial capillaries with dilatation and telangiectasis (Fig. 6b). Stagnation of



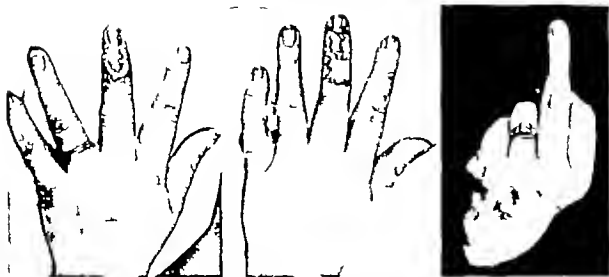


Fig. 13. Fluoroscopic burn following exposure to locate foreign body. Complete early resection. 11th immediate repair with split graft. One operation, normal function.

or dosage will be instituted. Typical lesions that are treated early and in which later dermatitis and chronic atrophy may result are hemangiomas, especially about the face (Figs.

9, 10) and plantar warts. Radiation lesions of the sole of the foot are especially difficult to treat; even cross-leg flaps may be necessary for repair (Figs. 15, 16).

Fig. 14. Fluoroscopic burn of doctor. a, b, Acute burns on both hands—left worse than right. Patient required six grains of morphine a day. Patient came in 11th consideration of amputation of hand. c, d, Result of general protective care and early resection and free grafting. Recovery as such that he is able to follow a full career in anesthesiology whereas he formerly was a surgeon.

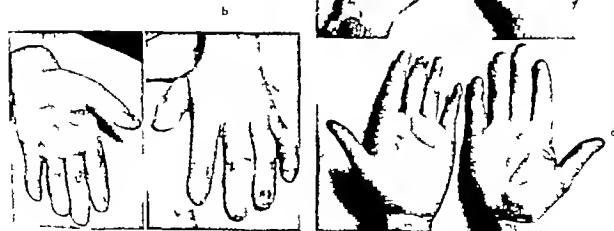


Fig. 14.



Fig 3. Dentist's burns. Typical burn of dentist's fingers from holding films in patients' mouths. Resection with immediate split graft. One operation.

It is hoped that none of these statements will be interpreted as underestimating the very great value of radiation therapy and x ray examination for many conditions the x ray is invaluable and indispensable. Recognition and elimination of the unfortunate ultimate results here discussed may lead to eventual wider usefulness of the various radiation procedures.

#### PATHOGENESIS

Wolbach reported the essential pathological processes which include

"1. Loss of appendages of the skin  
 "2. Replacement of normal collagen by a peculiar dense hyaline collagen rich in elastic fibers and poor in cells

"3. Obliterative processes in blood vessels of the corium and subcutaneous tissues.

"4. Necroses of varying sizes in the corium immediately beneath the epidermis. In the earlier stages these are usually in the region of thrombosed telangiectases. In the later stages telangiectasis may be nearly entirely absent.

"5. In response to necroses of the corium reparative proliferation on the part of the epidermis" which may extend beneath the telangiectasis or areas of necrosis. "These small necroses containing the thrombosed telangiectases become completely separated from the skin by the layer of regenerated epithelium and persist for a time as dry, dark-colored spots—the coal spots—until cast off. The significance of these processes lies in the fact

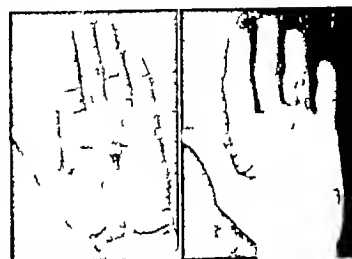
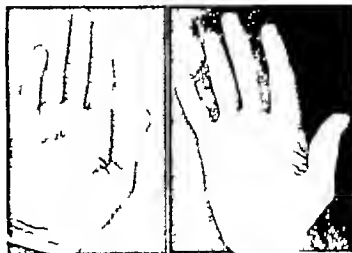


Fig 4. Eczema burn. Wide deep burns of both hands from treatment for eczema. Repair by resection and replacement of most of the skin of both palmar surfaces including fingers. Two operations were necessary. Function was about normal. To have additional work on fingers of right hand.

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The blood vessel changes may be of extreme importance. Early there is a marked thickening of the walls of the arterioles and venules at the junction of the dermis and subcutaneous fat (Fig 6a). The occlusive endophlebitis seems often to be more severe than the endarteritis, resulting in back pressure on the subepithelial capillaries with dilatation and telangiectasis (Fig 6b). Stagnation of



Fig. 5. Commercial hair remover burn. Excessive burning from commercial x-ray treatment to remove hair. Patient's arms, axillae and legs are completely burned. Treatment consisted of excision, in two stages, of all skin of lower arms and immediate split grafting.

the blood flow in these dilated capillaries is followed by thromboses, which later become organized and in the process may rupture the vessel walls with some leakage of blood cells into the subepithelial spaces. These black

coal spots are grossly visible and are usually several millimeters in diameter. It is well known that the dermis is intolerant of macroscopic foreign bodies (for example fine silk sutures will remain indefinitely in the subcutaneous tissues but they are always cast out of the dermis).

Thus the development of carcinoma in radiation lesions may be about the closest that we have come to the actual knowledge of the formation of carcinoma clinically. The epithelium is continually stimulated to downward growth for so many years to cast off the recurring "coal spots" (Fig. 6c) and to heal the recurring ulcerations that it finally loses the normal growth response (to these foreign body and wound stimuli) and just goes on to malignant change (Fig. 7).

The clinical stages of atrophy, telangiectasis, "coal spots," keratosis, and carcinoma are typical for chronic burns such as those found on physician's hands or such as follow repeated treatments given for acne, goiter or excessive

hair. The progress of the stages is different for different patients and different exposures but generally there is telangiectasis in from 3 to 10 years, coal spots and keratosis in 10 to 15 years and carcinoma in 20 to 25 years. Malignant change has been noted as early as 3 years, however.

An interesting thing is that in the donor site from which a split graft is taken to repair an x-ray burn the opposite reaction takes place in that the deep epithelial cells de-differentiate to re-cover the bare surface that is left when the skin is split in two.

The carcinomas that develop in radiation burns are usually squamous cell in type though occasional basal cell or basal squamous lesions are seen. The squamous cell lesions can and do metastasize while the basal cell lesions often show rodent ulcer characteristics, with deep local invasion.

X-ray burns are usually heavily contaminated with a wide variety of virulent bacteria. This is due partly to the many tiny crypts and recesses afforded by keratoses, recurrent ulcerations and cast-off coal spots, and partly to the cessation of sweat gland and sebaceous activity with loss of the normal skin-cleaning mechanism. The lesions may be so painful





Fig. 8. Widespread involvement following treatment for acne. As usual the tip of the nose being closest to the tube is the most burned. Repair by resection and immediate split grafting. Four operations are necessary to repair both cheeks, whole nose, upper lip.



Fig. 9. Early occurrence of burn following radium treatment of hemangioma. Repair by excision and full thickness graft from clavicular region. One operation.

that they are left grossly dirty because the patient simply cannot tolerate the added pain of having the wounds cleaned. This cleansing is an important factor in the consideration of any surgical treatment and its omission was responsible for some grave wound infections before the days of effective chemotherapy. A corollary to this is that these wounds and

areas will not tolerate the local application of strong antiseptics.

#### TREATMENT OF ACUTE BURNS

Acute burns are usually the result of a single massive dose, often with inadequate or no filtration. Such burns are most commonly sustained after fluoroscopy either upon the hands



Fig 10. Atrophy and deformity following radon treatment of hemangioma. Exclusion and repair with cross lip flap. Two operations.



Fig 11. Excruciating burn. Extreme involvement, with malignant loss of nose and chin and with multiple carcinomas throughout areas. Repair by complete excision and immediate free grafting. Four operations. Prosthetic acrylic nose made by Miss Gertrude Hance.

of the doctor (Fig 2) or in patients who have had elusive foreign bodies buried in the tissues.

Even in doctors the true nature of such burns is sometimes not apparent and so the lesion may be mistakenly treated as a severe allergic condition or as a dermatitis medica-

mentosa. These areas are apt to be markedly swollen and edematous, reddened weeping serum and characterized by excruciating deep boring throbbing pain. They typically become worse each day for a week or two, and seem to be refractory toward all treatment. In the worst cases, the skin may turn white



Fig. 8. Widespread involvement following treatment for acne. As usual the tip of the nose being closest to the tube is the worst burned. Repair by resection and immediate split grafting. Four operations were necessary to repair both cheeks, whole nose, upper lip.



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Fig. 14. Athlete's foot burn. Extremely crippling x ray burns following treatment of athlete's foot. Resection of lesion and immediate repair with thick split grafts. Two operations—one over ankle and one over most of heel.



degree. Getting it fresh and keeping the bulky split leaf in place are details that few patients will carry out very long, however.

Burned areas are less painful if they are sealed off from the air by some bland ointment (e.g. cold cream or lanolin *not autoclaved*) and a loose soft cotton dressing without any gauze next to the skin. Elevation and immobilization of hands may be quite helpful. Strong antiseptics, especially those containing heavy metals, are to be avoided. Gentleness, cleanliness, and the avoidance of irritants are the fundamentals necessary for good local treatment.

The use of ultraviolet or further radiation of any kind is definitely not advisable and is mentioned here only because it has been recommended. There seems to be no justification to use further radiation therapy in an effort to relieve such lesions which are in themselves the result of exposure to too much radiation.

If the burn has been from a single cauterizing dose in which the limits are fairly well defined and ulceration seems likely with little chance of adequate healing, early excision and grafting may be worth trying. The depth of the trouble may not be apparent, however, and there may be difficulty in growing a free skin graft.

#### TREATMENT OF CHRONIC BURNS

The diagnosis of chronic burns is often missed because the patient may be unaware of the cause of his condition. This fact is true

even in some physicians who do not associate the chronic dermatitis of their hands with the holding of a fluoroscopic screen for a few minutes each week. The power of recovery of the tissues from the long continued effects of radiation seems to be slight or nil, so that the status of a given individual's skin seems to be determined by the cumulative amount of radiation that he has received throughout his life.

The triad of atrophy, telangiectasis, and keratosis of the skin should lead to the diagnosis. About the only condition that is to be

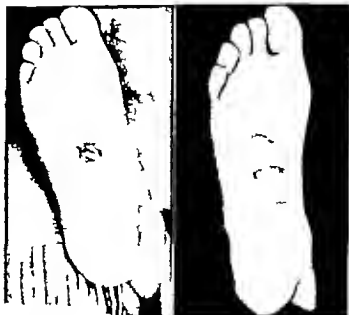


Fig. 15. Fluoroscopic burn. Extremely painful, completely crippling lesion from one fluoroscopic examination following injury. Involvement clear through onto dorsum. Relieved in two operations by wide excision and split grafting.





Fig. 2. Malignant breakdown of an old ray burn, in an area treated for tuberculosis of the lymph nodes. Wide deep resection of the carcinoma (done by Dr. Bradford Cannon) and secondary repair with thick split graft. Two operations.



Fig. 3. Acne burn. Widespread burn in section and immediate free graft shown after one operation. One operation.

after a few days (as in a deep fire burn) and then slough leaving a foul greenish-gray sloughing ulcer. In the milder burns, the redness, swelling and pain gradually subside and for a few months at least the skin appears fairly normal.

The pain in acute burns may be so severe as to require hospitalization and heavy sedation. One patient required 6 grains of morphine a day and the tendency here is noteworthy of caution.

As some acutely burned areas recover or at least persist as adequate cover for the part, and as there is not much chance of determining the extent of damage of an acute burn very early operation is seldom indicated.

Local anesthetics are usually unavailing and may add a secondary drug dermatitis. The use of aloe vera (an antipruritic which was formerly used for a variety of skin conditions) has been suggested and if obtainable may relieve itching and some pain to a worthwhile



Fig. 19. Pruritis and treatment. Excessive in 4th element, repaired by excision and immediate grafting. Two operations.



Fig. 20. Fluoroscopic burn. a, left, Wide deep involvement following chest examination. Repaired later in one operation. b, Another patient with similar burn the result of gastrointestinal fluoroscopy but with a direct flap added to cover a deeper involvement.

is that the excision and repair should be done when the area is in relatively good condition—not waiting until ulceration pain and malignant change have occurred. However many patients wait for repair until these stages have occurred so that the greatest surgical problem lies within this group.

Faint telangiectasis and atrophy may not require treatment if it is very slowly progressive but even in this group excision and repair are sometimes indicated for cosmetic improvement.

Bland ointments may soften coal spots and keratoses and seem to stop them for a time, but the underlying pathological changes are progressive and later become manifest. On hands, keratoses develop with the coal spot stage and these may rapidly become malignant. These spots can best be removed in mass and the areas skin-grafted. It is less

desirable but feasible in some patients to do caustic excisions of the individual keratoses as they occur and let the areas heal by secondary intention. These are the unusual lesions for which more radiation is sometimes recommended but it should *not* be used as it is apt to accelerate the progress of the pathological changes. For the same reasons, carcinomas in x ray burns should *not* be treated with more radiation.

When it is decided that a radiated area needs excising the size depth location ulceration and malignant change in the area should be carefully considered. The basic therapy is wide deep excision followed by immediate closure of the wound with the use of free split skin grafts. The following variations in technique are sometimes useful.

1. The wound is left open to be skin-grafted later. This step is taken because these areas

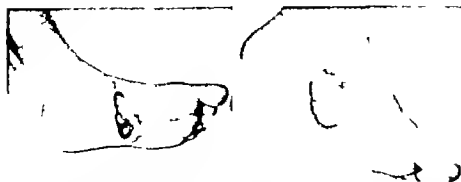


Fig. 6 Sole of foot burn extending so deep that cross leg flap had to be used, rather than free graft. Two operations.

differentiated is "sailor's" or "farmer's" skin which is similar but is caused by the cumulative effect of decades of overexposure to sunlight in persons who do not form sufficient melanin to protect themselves (in other words, they do not tan). Differentiation can be made by the history and by the fact that sailor's skin symmetrically affects both forearms, both hands, and the entire face and neck in most patients. Telangiectasis is often predominant in x-ray burns, whereas atrophy and keratosis predominate in "sailor's skin". Coal spots rarely occur except in association with x-ray burns. Carcinoma may develop in either.

The progress of a severe chronic x-ray burn through the stages of atrophy, telangiectasis,

coal spots, keratosis and carcinoma is irreversible and inevitable if the patient lives long enough. This course is not affected by the use of any drugs or other means of treatment known at present except the surgical excision and repair of the area. The stages may overlap and the speed of the progress varies greatly so that it is often a major problem to decide when and if to undertake excision. Fast progress in any patient and even slow progress in a young individual are indications for treatment. A paradox of treatment



Fig. 7 Commercial x-ray treatment for removing hair resulting in almost total burns of lower legs.



Fig. 8. Same patient as in Figure 7 shown after repair by wide resection and grafting. Surrounding involved area done at subsequent operation.

they should be examined and watched periodically for possible regional lymph node involvement. One of the main difficulties of course is to get the physician to submit to an adequate operation.

**Face.** Radiation burns of the face carry the added responsibility of securing not only good repair but a good cosmetic result. The paradox here is that radical operation should be done early before the features have been damaged by the development of carcinoma. At times when patients have been treated for acne or eczema it is necessary to excise and replace the skin of the entire face—nose, cheeks, lids, forehead, eyebrows and chin. If excision can be done early enough so that free skin grafts can be used the functional and cosmetic results are far better.

It has been noticed that the little difference in closeness of the tip of the nose to the x-ray machine usually produces enough more radiation as to cause greater damage here and in addition a resulting chronic mucositis of the nose if not a burn must be treated.

**Feet.** Radiation lesions of the sole of the foot form a story of their own; there are frequent histories of years of debility and great difficulty of repair. Prophylaxis is as important here as in any region for the disability may be extreme and prolonged.

The rules of treatment are the same—excision and repair. Free split skin grafts can be used even for wide areas if operation is undertaken before ulceration has occurred. Small ulcerations if not too deep can often be repaired by local flaps or free grafts but cross leg flaps are almost always needed for repair of extensively ulcerated lesions. The idea of cutting into the sole of the opposite foot to secure a graft for the repair of a damaged one is mentioned only because it has been advocated and to suggest that it should never be done.

Neuroscopic burns of the foot may cause some of the most distressing deep involvements encountered. Where the plantar fascia is involved shreds may be extruded at intervals for months with total disability and considerable pain throughout that time. The deep joint strictures as well as the opposite surface of the foot are especially apt to suffer



Fig. 2. Hemangioma treated by radium in childhood (elsewhere with malocclusion); urethral replacement of entire half of face; delayed chest flap.

in these foot lesions. The chronicity of the process far outweighs any value of the fluoroscopic examination.

**Perianal area.** Perianal and perivulvar burns (usually from treatment of pruritus) offer their special problems in repairing such contaminated areas and dressing such a difficult field (Fig. 19). Excision and immediate or delayed free grafting or the immediate shifting of local flaps inward and the grafting of their sites is usually carried out. Possible troubles from a circular scar near the pectinate line should be considered and avoided if at all possible.

Cooperative preparation may include enemas and laxatives to empty the bowel and oral streptomycin or sulfasuxidine to reduce the bacterial flora. Frequent Sitz baths may help in preparing the local skin.

At operation the stent type of fixation may be used on grafts; long edge sutures are tied over a pad of gauze to immobilize the graft and dressing and the edges are surrounded with zinc oxide or some other impervious ointment. The use of a retention catheter and low residue diet for 7 to 10 days may help greatly in the prevention of soiling. After that period cleaning of the grafted area after each soiling is carried out with the grafts usually becoming quite stable and requiring little further care after a period of 2 to 3 weeks.

**Relief of pain by operation.** Pain in these burns may be so severe and so refractory to



Fig. 1. Abdominal area burn following treatment for gastric testal tract lesion. Complete excision, immediate grafting. One operation. 8 days in hospital.

are apt not to have a very good minute (capillary) blood supply (even though blood may pour over the whole field from a few arterioles and venules) and with an inadequate minute blood supply transplanted tissue does not survive.

2. The wound may just be dressed in a split graft and the patient advised that the graft may not take and that the graft may have to be repeated if it is suspected that the blood supply is inadequate.

3. Immediate flap closure of the defect either by adjacent flaps or distant flaps prepared ahead of time may be necessary and definite plans should be made for such a contingency.

4. Delayed closure of defects with pedicle flaps may be indicated. This is true when there is no doubt that the area needs a flap and when the depth of excision is uncertain as for instance around the vertebrae or in any place in which the adjacent nerve supply must be protected.

5. In the presence of exposed bone or tendons, pedicle grafts should be used. Free grafts do not do well over bone and will not grow directly on bare bone or bare tendon (if the area is more than a few millimeters wide) whereas pedicle flaps will usually survive and successfully attach themselves in such situations.

There are two essentials: (1) to get rid of the lesion and (2) to repair the area for useful function and appearance.

The persistence of function of skin grafts will be satisfactory if the involved tissue has

been excised widely and deeply enough. Edges should be watched and if deep trouble develops wider and deeper removal and repair may be necessary.

The preparation of wounds for operation consists of local cleansing, the use of mild local antiseptics (such as 1:5,000 aqueous zephiran) and on feet non-wettable agents (such as some of the silicate-gel preparations) may be used to prevent maceration of the surrounding skin under the wet dressing.

These basic steps for repair are used throughout the body but some local areas may be considered separately.

**Hands.** Chronic a ray burns of the hands occur most often in physicians and dentists and respond well to wide removal of skin and repair with thick split grafts. The heaviest burn may be either on the dorsal or palmar surface but the opposite surface is nearly always involved to some extent. Excessive pain may occur and require heavy sedation. In lesions of very long duration the individual blood supply to the fingers may be of such low quality that care has to be exercised in maintaining what there is available—in not doing too radical operations—not sacrificing both arteries of a finger at one time—not getting bandages too tight. When definite carcinoma has developed very wide deep excision is necessary but since excision cannot be very deep without sacrificing function amputation must always be considered as possibly the best and safest procedure in some patients. These lesions do not always remain local.



sedation as to require immediate wide deep excision of the lesion with or without primary repair. When pain is so outstanding very dramatic relief is usually obtained by excision. The patient upon awakening from the anesthetic and in spite of the discomforts of the operation will volunteer the information that his pain is gone.

Severe pain may occur in lesions on the neck in areas adjacent to bone and in lesions along the vertebrae where root pain may be excessive. One patient with severe abdominal pain who had a large burn of the back was nearly subjected to a laparotomy but was completely relieved of his abdominal pain by deep excision of the ulcer on his back (Fig. 20). This is likewise especially true in patients with painful anal lesions.

The pain from excessive radiation about the jaws is one of the most difficult to alleviate.

#### FINAL REMARKS

These lesions are unhappy ones from every possible aspect and they are more common than is generally believed. Their prevention should be paramount in all instances of exposure. Their occurrence should be recognized early and complete excision and repair should be done before malignant changes occur (Fig. 21). Such a regimen will greatly reduce the total amount of disability and suffering in these patients.

It may be repeated that severe lesions are progressive and that surgical treatment should be undertaken before serious ulceration occurs and carcinoma develops.

# IMPERFORATE ANUS

## A Case Series and Preliminary Report on the One Stage Abdominoperineal Operation

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**I**MPERFORATE anus was recognized and described in the third century A.D. but it was not until 1835 that the operation of perineoplasty with mobilization of the rectal pouch was recommended. In 1844 Velpeau advocated sigmoid colostomy following unsuccessful perineal dissection. With the use of these procedures and primary colostomy, the operative mortality has remained essentially unchanged since 1915 (6, 21).

### INCIDENCE

Congenital anomalies of the anus and rectum are said to occur in the ratio of 1:5000 to 1:10000 live births. Males are affected somewhat more often than females. This disparity was greater than 2:1 in this series. It is unusual to have similar anomalies in siblings but this does occur. Two sisters were so affected in the group of cases at hand.

### EMBRYOLOGY

The development of the lower rectum, anus and urogenital tract have been described in detail by other authors (1, 2, 4, 6, 7, 13, 14 and 18). In brief, these structures become differentiated between the fifth and eighth weeks of embryonic life. At first the allantoic duct and the hindgut form a common cavity, the cloaca, which is then divided by a downward growth of mesoderm, the urorectal septum, into an anterior portion, the forerunner of bladder and urethra, and a posterior portion, the primitive rectum. The anus is formed by an external invagination, the proctodeum, separated at first from the rectum by the anal membrane, which later ruptures, establishing continuity of the lower gut.

Rectourinary fistulas represent a failure of

the urorectal septum completely to divide the cloaca. In the female, the müllerian ducts, the lower portion of which form the uterus and vagina, descend in the urorectal septum, taking over any fistulous connections, if present.

The external anal sphincter develops from the regional mesoderm and therefore smooth muscle is usually present in the perianal area in spite of anomalous anal development. However, the position and function of this muscle are frequently distorted by the anomaly (4).

### TYPES OF ANORECTAL ANOMALY

Malformations of the anus and rectum are usually classified into four main types (13, 14) (Fig. 1). In type I, there is a stenosis of the anal mucocutaneous junction or of the lower rectum due to incomplete rupture of the anal membrane. No actual atresia is present. Type II is an imperforate anus with a persistent anal membrane only. Type III is an anomaly in which the rectal pouch ends blindly at a variable distance above the perineum. It is thought to be due to excessive degeneration of the postallantoic portion of the hindgut (13). The anal site is often represented by a dimple in the skin. This type is by far the most common (6, 10, 12, 13, 14, 18). In type IV, the anus and lower rectum are normally developed. The upper rectum ends blindly at a variable distance above this distal portion, probably due to confluence of the superior portion of the rectal ampulla (13).

Fistulas may be present in any one of the four types of anorectal anomaly but are most commonly seen in type III (Fig. 2). In type IV, (6, 12, 13, 14, 18), multiple fistulas are extremely rare (13, 14). In males, the fistula may be rectovesical, connecting the rectal pouch with the bladder in the vicinity of the trigone, rectourethral, extending from the



TABLE I.—TYPES OF ANOMALIES

Type of anomaly	Males	Females	Type total	Total fistulas in each type
I				
II				3
III	5		27	26
IV				
Totals	56	6		30

pouch to the prostatic or membranous urethra or rectoperineal a tract leading from the rectum externally to the perineum anterior to the anal dimple. In females, the fistula may be rectovaginal or rectoperineal. Rectourinary or rectouterine fistulas are very uncommon. High rectovaginal fistula does occur although most of these tracts open into the lower third of the vagina or into the vulva immediately anterior to the fourchette. High fistulas include rectourinary and high rectovaginal connections. Lower rectovaginal, rectovulvar or rectoperineal are termed low fistulas.

In this series of 52 cases, there were 3 patients with type I anomaly, 13 of type II and 37 of type III. There was no patient with a type IV defect. A fistula was present in 29 of these cases, or 55.8 per cent (Table I).

The distribution of various fistulas is shown in Table II. Attention is drawn to the fact that all but 3 of the fistulas occurred in patients with a type III anorectal defect, a fistula incidence of 70.3 per cent in this type.

#### CLINICAL EVALUATION

In general patients with congenital anorectal anomalies fall into two main clinical divisions. The larger group consists of type I cases with extreme stenosis, and the other types without a fistula or with a narrow fistula who enter the hospital with actual or impending intestinal obstruction. The smaller division includes the more common type I case, together with the other types having a low fistula of a size sufficient to pass feces. These enter for correction of the malformation and frequently for relief of chronic partial obstruction with fecal impaction. In this series there were 33 patients of the first or emergency group. The average age of entry was 27.0 hours. There were 12 patients of the second clinical divi-

TABLE II.—DISTRIBUTION

Fistula	Type II males	Type II females	Type III males	Type III females	Total fistulas
Rectoenteral			6		6
Rectoenteral			6		6
Rectovaginal				16	16
Rectoperineal	3				3
Totals	3		12	16	29

sion varying in age from 6 days to 3 years, averaging 8.3 months on entry. The type I cases were the youngest patients of this group, the type III cases with low rectovaginal fistulas, the oldest. The 7 remaining patients of the series entered the hospital for secondary operations, the primary procedures having been performed elsewhere.

Of the 33 patients in the potentially obstructed group only 4 showed clinical evidence of actual obstruction. Two of these entered at the age of 48 hours, the others at 60 and 72 hours respectively. All exhibited abdominal distention in moderate degree in testinal patterning was present in 1. Seven of the potentially obstructed patients were subjected to laparotomy at ages varying from 3 to 77 hours and all showed varying degrees of colonic distention at surgery although in only the oldest 2 was clinical abdominal distention noted preoperatively. One-third of the nonemergency group of patients entering at a later date for correction of the anal deformity had chronic partial large intestinal obstruction with fecal impaction palpable abdominally.

The diagnosis of the type of anomaly can be made by inspection and palpation of the anal and urogenital regions (13, 14). A dimple was noted at the anal site in 13 and puckering of anal skin in 2 of 37 cases of type III anomaly. It is felt that one or the other of these signs occurs in a greater percentage than these findings indicate. External fistulas (rectoperineal and low rectovaginal) are readily apparent but rectourinary and high rectovaginal fistulas often escape detection. A careful preoperative gross and microscopic examination of the urine should be made in all patients in whom no external fistula is apparent. However a high narrow fistula may be blocked temporarily with inspissated meconium and produce no

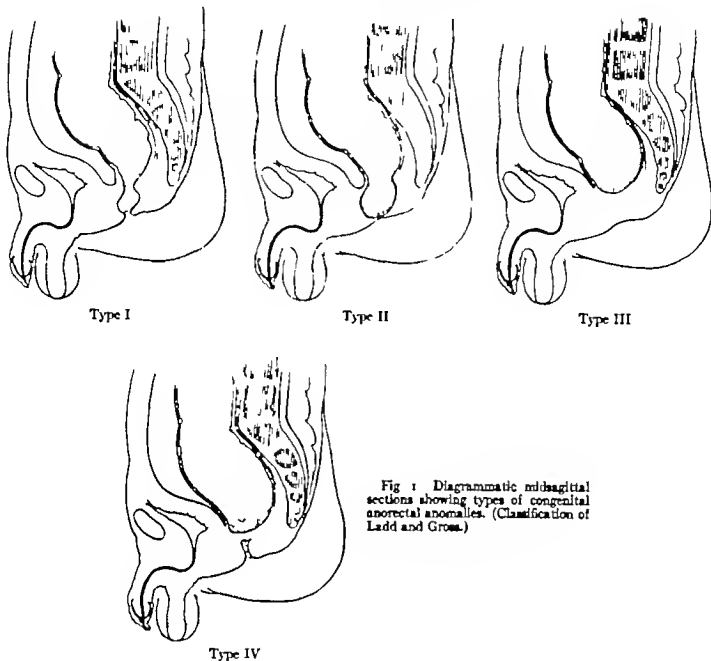


Fig 1. Diagrammatic midsagittal sections showing types of congenital anorectal anomalies. (Classification of Ladd and Gross.)

immediate evidence of its presence (13, 14). Of 14 rectourinary fistulas (all in males) 7 were not diagnosed prior to operation. Although not all of the primary procedures were performed at this hospital this represents an overall diagnostic failure of 50.0 per cent in the early determination of rectourinary fistulas. Of 10 rectovaginal fistulas 2 (both high in the vagina) were not diagnosed preoperatively. Considering the inevitability of retrograde urinary infection when these high fistulas especially those connecting the rectum with the urinary tract remain open (6) early diagnosis and treatment is of primary importance.

#### ASSOCIATED ANOMALIES

Additional developmental anomalies were found in 24 or 46.1 per cent of this series of cases. Other writers (1, 6, 10, 11, 13, 18) have found the proportion of associated anomalies to vary from 28.0 to 68.7 per cent. Of the 24 cases at hand 19 or 79.2 per cent were males and 18 or 75.0 per cent were patients with type III anal anomalies. This relatively higher incidence of associated anomalies in males with type III anal defects has been noted previously (10). These additional malformations involved the genitourinary system most fre-

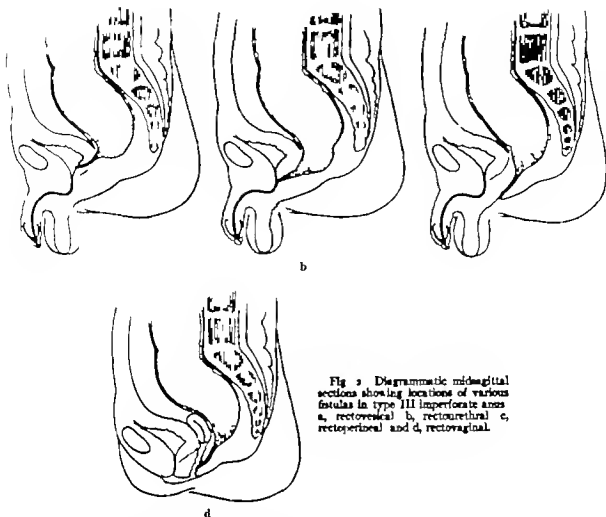


Fig. 3. Diagrammatic midsagittal sections showing locations of various fistulas in type III imperforate anus: a, rectovesical; b, rectourethral; c, rectoperineal; and d, rectovaginal.

quently occurring in 14 cases. There were 10 additional gastrointestinal malformations, 8 patients with anomalous cardiac development, 4 with skeletal anomalies, 3 with mongolism and 1 with a defect involving the larynx. The largest number of additional anomalies in any one patient was 5. Death was attributable directly to the associated anomalies in 8 patients; these malformations were contributory in the death of 2. All but 2 of these deaths were in males of type III. This represents a mortality of 15.4 per cent of the entire series. The deaths due to these anomalies are 42.1 per cent of the overall mortality.

Of particular interest are the additional malformations of the gastrointestinal tract, 10 in number, of which 4 were directly respon-

sible for death. Three of the fatal defects were tracheo-esophageal fistulas, the fourth a duodenal atresia. It is said that anal defects are the developmental lesion most commonly associated with esophageal anomalies. Reports of these concurrent malformations are frequent in the literature (11, 13, 21, 22). Awareness of the association and careful search for a possible esophageal defect is important, especially in males with the type III anal anomaly, since the operative correction of the esophageal lesion must take precedence over that for the anal defect.

#### TREATMENT OF ANORECTAL MALFORMATIONS

Type I anomaly is treated by repeated anal dilatations daily at first decreasing in fre-

quency as the function of the anus approaches normal. Care should be taken to traumatize surrounding tissues as little as possible in order to avoid scar tissue formation. Should the external aperture be very small, cruciate incision of the remaining membrane is indicated. If stenosis is produced by a fold higher in the rectal ampulla, longitudinal division of the structure followed by transverse closure has been advocated (7). Few patients with this type enter the hospital; only 2 are present in this series. One of these died shortly after birth of congenital heart disease; the other has only fair anal function at the age of 12 years. A firm scar is present at the mucocutaneous junction causing incontinence when the stools become loose.

The treatment of type II malformation has consisted of cruciate incision of the obstructing membrane or of excision of the membrane and suture of the anal mucosa to the skin. Both procedures are followed by repeated dilatations. Eleven patients were so treated. Two others were admitted for resection of stenosing scars or bands; one following primary treatment elsewhere, the other following spontaneous rupture of the membrane. Eleven of these patients are now living and well with satisfactory anal function, although one required secondary excision of a perianal scar. There were 2 fatalities. One was due to a congenital laryngeal anomaly; the second who died at home of undetermined cause 1 week following discharge from the hospital is considered an operative death. Three fistulas were present in this group, all of which were rectoperineal in location, small and superficial. All closed spontaneously after being opened at the operation and allowed to heal by granulation.

The classic method for treating the majority of cases of type III anal anomaly is a procedure called proctoplasty or perineoplasty. This operation consists of approaching the rectal pouch from below through a vertical midline perineal incision. The blind rectal end is dissected free from surrounding tissues and drawn downward to be sutured without tension after opening to the skin about the anal site. If the primary proctoplasty is unsuccessful because the operator failed to find the rec-

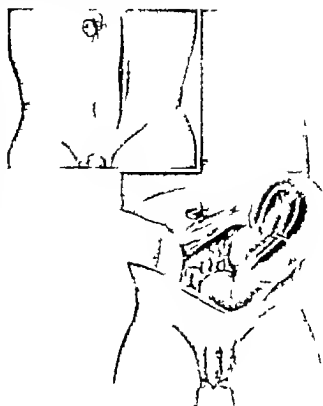


Fig. 3. Technique of abdominoperineal rectal replacement. A left lower rectum, muscle-splitting incision is made (inset). The distended sigmoid colon is allowed to eviscerate.

tal pouch or to mobilize it sufficiently to bring down without tension, high sigmoid colostomy has been advocated. In some cases, usually those in a relatively poor preoperative condition, primary colostomy is performed without an attempt to dissect the perineum.

Fistulas occurring with type III imperforate anus are variously treated. Low fistulas (rectoperineal, rectovulvar, and low rectovaginal) have been successfully closed at the time of the primary proctoplasty by division or excision of the fistulous tract and the mobilizing of the rectum sufficiently to exteriorize the rectal end of the fistula (13). Frequently a low fistula with a stoma adequate for passage of feces is simply dilated to relieve obstruction, correction of the anomaly being postponed until the patient is over 3 years of age. At this time proctoplasty is performed, usually preceded by sigmoid colostomy, which is then closed as a third stage operation at a later date. High fistulas (rectourinary or high rectovaginal) are corrected at an earlier age. Several months after the primary proctoplasty,

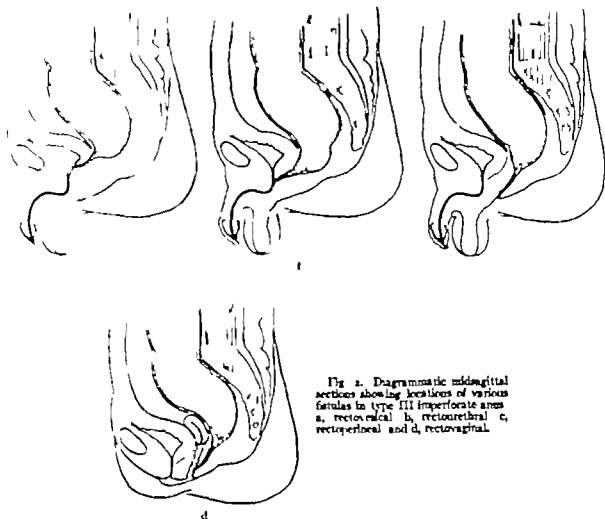


Fig. 2. Diagrammatic midsagittal sections showing locations of various fistulas in type III imperforate anus: a, rectovaginal; b, rectourethral; c, rectoperitoneal; and d, rectovaginal.

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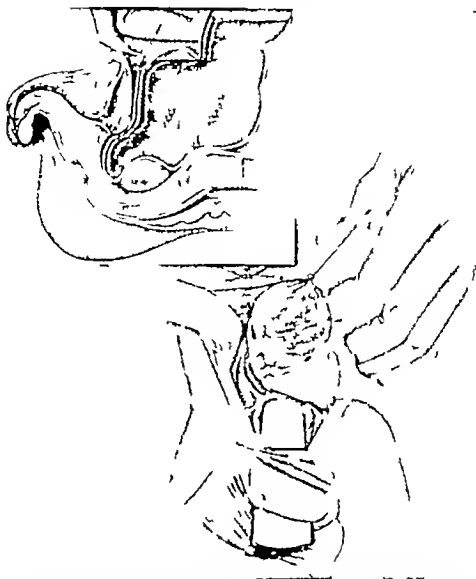


Fig. 5 The rectal pouch is further released by posterior dissection (inset). (The dotted line represents the dissecting finger.) At the completion of this stage of the operation there is sufficient bowel to reach the perineum without tension.

cent. Another patient died of peritonitis secondary to bilateral acute streptococcal salpingitis during the interval prior to closure of her rectovaginal fistula several months after a primary dilatation. Three of these 11 patients are still waiting for further operations; 2 new patients having had the primary procedure await the beginning of the various stages of the fistula repair while 4 have been lost to follow up before discharged as cured.

It is evident that in addition to this primary and secondary mortality there is a large and incalculable morbidity expressed in readmissions and total hospitalization involved in the classic treatment of type III anorectal anomalies. For this reason we have recently

attempted to correct the anal deformity and close the fistula in certain of these cases with one operation: an abdominoperineal replacement of the rectum (Figs 3, 4, 5, 6, and 7).

The skin of the infant is prepared on all aspects from axillae to below the knees; he is placed upon a sterile sheet and the feet and legs are wrapped separately in sterile drapes. A left lower rectus muscle splitting incision is made. The dilated loops of colon are allowed to eviscerate and are covered with warm moist packs. Sufficient gas and meconium within the pelvic colon are gently milked proximally to allow adequate exposure of the pelvic floor. The peritoneal reflexion is incised about the rectum and the dissection is

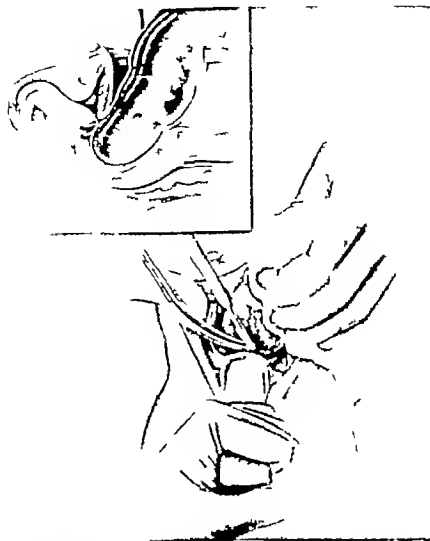


Fig. 4. Dissection is carried anteriorly about the rectal pouch and the fistula identified (inset). The tract is then divided between clamps.

a sigmoid colostomy is made followed after a varying interval by isolation and division of the fistula usually through an abdominal approach. For rectourinary fistulas a suprapubic cystotomy is frequently performed with this stage. Later the cystotomy tube is removed and finally the colostomy is closed. As the artificial anus tends to contract during the period of disease dilatations or plastic repair of the perianal scar are often necessary following closure of the colostomy.

In this series of 37 cases of type III anorectal anomaly, 34 were subjected to primary operations with 7 deaths a mortality of 20.6 per

cent. Table III lists the primary procedures used and the mortality of each.

In the literature one finds that the mortality of primary successful proctoplasty varies from 11.7 to 22.2 per cent (13, 18, 24) that of primary colostomy from 18.0 to 25.0 per cent (18, 24) and that of unsuccessful proctoplasty followed by colostomy from 68.7 to 84.6 per cent (13, 24). Except in this last category the fatality rate approximates the average range.

In addition to the primary operations of the present series, 11 patients had 40 secondary "stage" procedures performed with 1 operative death an additional mortality of 9.1 per

TABLE III.—PRIMARY PROCEDURES

Primary operation	Number of infants operated upon	Operative deaths	Operative mortality per cent
Proctoplasty (successful)			8.3
Proctoplasty (unsuccessful)	3		33.3
Colostomy (following unsuccessful proctoplasty)	4		5
Colostomy (primary)	6		6.7
Dilatation of Setula	5		
Abdominoperineal replacement	4		3
Abdominoperineal replacement (following unsuccessful proctoplasty)			00
Totals	34	7	20.6 Average

Preoperative and postoperative care is similar to that practiced in atresias elsewhere in the gastrointestinal tract (23). A Levine tube is passed into the stomach in all cases prior to operation (A tracheo-esophageal fistula may be discovered at this time). The stomach is kept empty by means of the tube during the operation and for 12 to 24 hours thereafter. A vein is cannulized prior to operation and electrolytes, blood or plasma given as indicated during the procedure. Open drop ether anesthesia is used. Postoperatively constant intravenous hydration is maintained to give 10 to 15 cubic centimeters of saline per pound per day and total fluids of 50 to 75 cubic centimeters per pound per day. Transfusions of 50 to 75 cubic centimeters are given as indicated. Feedings are started as in the postpyloric regimen after 24 hours and gradually increased as the normal motility of the bowel is attained. Penicillin or streptomycin may be given prophylactically. The anal sutures are removed on the tenth postoperative day. Gentle anal dilatations are begun on the fifth postoperative day and continued daily for several weeks, diminishing in frequency as the anal function approaches normal.

It is felt that the abdominoperineal replacement of the rectum is indicated in all early cases of type III anorectal anomaly with evidence of rectourinary or high rectovaginal fistula and in all such cases without evidence of fistula since both the incidence and the error in diagnosis of such fistulas in these patients are known to be high. However when these

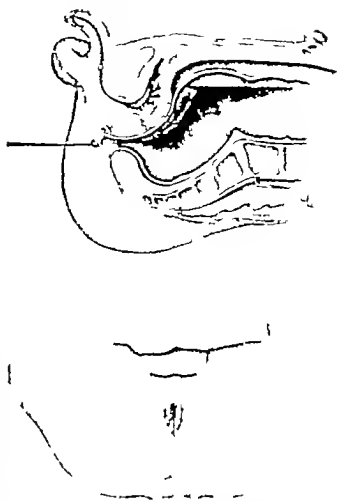


Fig. 7. a, above. The full thickness of the rectum is approximated to the perineal skin and the excess, ligated portion of the bowel removed. b below. Illustrates the final appearance of the anal region and perineal wound.

infants are seen late (over 60 hours of age) especially if considerable abdominal distention is present they are probably best treated by primary proctoplasty or colostomy depending upon the general condition and the distance between the perineum and the rectal pouch as determined by roentgenograms. In such cases where there is little abdominal distention the abdomen may be opened as for the abdominoperineal procedure. If however sigmoid distention precludes adequate exposure of the pelvic floor a high sigmoid colostomy may be carried out and the abdomen closed. Cases of type III anomaly with low narrow rectovaginal or rectoperineal fistulas should have a primary proctoplasty with division and extensorization of the fistula. Less preferably a primary dilatation of a wider



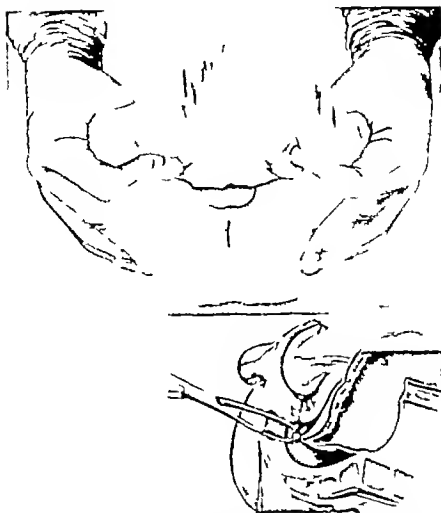


Fig. 6. The assistant holds the infant in exaggerated lithotomy position, and short vertical, midline incision is made through skin and subcutaneous tissue overlying the anal dimple. A clamp is then placed through the exact center of the dimple, spread gently and the ligated rectal end of the fistula drawn through to the exterior.

carried inferiorly to expose the blind rectal end and the fistula (if one exists). This is divided between clamps and ligated with fairly heavy chromic catgut. The ends of the ligature on the rectal side are left long. Further dissection of the pouch continues until the rectum is sufficiently free to be drawn downward to the perineum without tension. A short vertical incision through skin and subcutaneous tissue only is then made in the perineal midline. With a blunt instrument this opening is connected with the superior area of dissection through the center of the anal dimple, thus saving as much of the anal

sphincter as possible. The ligated portion of the rectal pouch is grasped and drawn through the perineal wound. The sigmoid colon completely covers the pelvic peritoneal defect so that no reoperation is necessary. The abdomen is closed with interrupted figure of eight sutures of fine stainless steel wire uniting peritoneum, muscle and fascial layers. Interrupted sutures of nonabsorbable material are used to close the skin. The ligated end of the rectal pouch is removed with scissors after the full thickness of the rectum has been approximated to the skin of the perineal incision with interrupted nonabsorbable sutures.

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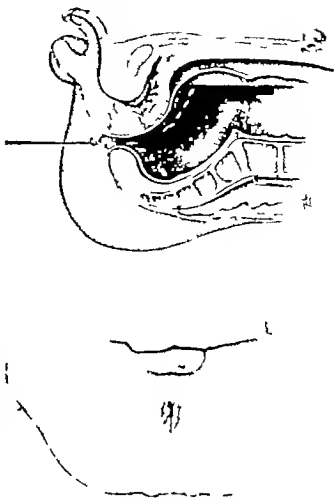


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Fig. 8. Roentgenogram of infant with type III imperforate anus at the age of 2 hours, using the Wangenstein and Rice technique. Gas had not entered the pelvic colon sufficiently to localize the rectal pouch. At operation, shortly afterward, the rectum was found to terminate slightly below the pelvic peritoneal reflexion. A rectourethral fistula was present.

low fistula may be carried out followed by colostomy and secondary proctoplasty at a later date. The primary abdominoperineal replacement or some other single stage operation is probably indicated in type IV anorectal anomalies when seen early, although we have had no experience with them. The operation is definitely contraindicated following attempted, unsuccessful proctoplasty.

This is a preliminary report in that the primary abdominoperineal replacement of the rectum has been performed in only 4 cases. One infant died due to an associated anomaly. The second had normal postoperative bowel and anal function but his course was marked by recurrent periods of cyanosis, fever and occasional abdominal distention. There was a marked and unexplained anemia. A gastrointestinal series at about 5 weeks of age revealed no anatomic nor functional abnormality and there was no evidence of peritonitis.

After 7 weeks the infant expired. Unfortunately no autopsy was obtainable. Although we include this as an operative death, an associated cardiac anomaly appears to be the more likely cause. The 2 other patients are living and well at the ages of 4½ years and 10 months, respectively. The anal function of the elder is normal, the perianal scar is soft and a small but functioning sphincter is present. The younger patient has no evidence of an anal sphincter and no voluntary control has yet appeared. The anus admits the fifth finger with ease and the scar remains moderately soft. The operative mortality is, therefore, 25 per cent up to this time.

#### ROENTGENOGRAPHY PRIOR TO OPERATION

Because of the nature of the abdominoperineal procedure, the earlier the patient comes to surgery, the less the distention and the simpler the operation. The Wangenstein and

TABLE IV—RESULTS

Type of anomaly	Total cases of each type	Anal function				Cases between operative stages	Deaths (all causes)	Lost to follow up
		Normal	Good	Fair	Poor			
I								
II	12	0	3					
III	17	3	3	4	2	5	16	4
Total	29	3	6	4	2	5	16	4

Rice technique for obtaining roentgenograms of the abdomen with the infant held head down and a marker at the anal dimple has been found inaccurate before the age of 24 hours by numerous observers (1, 12, 13, 14, 18, 31). The films of 3 of our patients taken at the ages of 2, 13, and 14 hours respectively, illustrated this error. In each case, at laparotomy shortly following this diagnostic procedure the rectal pouch was found to be at the level of or just below the pelvic peritoneal reflexion. In no case had the gas approached this region, according to the films (Fig. 8). To postpone the operation until accurate roentgenograms may be obtainable increases the hazard to the patient by increasing the difficulty of exposure at the time of surgery. The x-ray procedure is somewhat traumatic, especially if the infant is held head down for some minutes and the abdomen massaged in an attempt to cause gas to enter the rectal pouch (32). The films give no information regarding the presence or location of high fistulas. For these reasons it is felt that preoperative roentgenograms may frequently be omitted in infants seen at an early age, in which the abdominoperineal operation is indicated.

#### RESULTS OF TREATMENT

The results of the treatment of imperforate anus are difficult to evaluate accurately prior to the age of 2 or 2½ years when toilet habits have developed. If the child has control of evacuation even when the feces are loose (as in diarrhea or after catharsis) normal anal function is considered to have been attained. If control is present when the feces are of normal consistency and incontinence occurs only with watery stools the anal function is considered "good." Function is only "fair" if con-

TABLE V—MORTALITY

Anomaly type	Total mortality	Operative mortality	Mortality from associated anomalies	Mortality from other causes
I	30.0%	0%	30.0%	0%
II	14	7.7	7.7	0.0
III	43	13	6.8	5.4

Figure is based on infants operated upon and includes fatalities following both primary and secondary operations.

trol is lost with soft stools, and "poor" if total incontinence or alternating incontinence and impaction occur. Patients in these last two categories usually require further surgical treatment. The best results are seen in those children who develop a palpable anal sphincter. The preponderance of good results in this series occurred in patients with type II anal anomaly (Table IV).

Some aspects of the mortality have been discussed. Table V presents the fatality statistics in further detail. The total fatality rate for the entire series is 36.5 per cent, the over all operative mortality being 17.3 per cent that from associated anomalies 15.4 per cent and from other causes, 3.8 per cent.

#### SUMMARY AND CONCLUSIONS

The various types of congenital anal anomalies together with commonly associated fistulas are described. Fifty-two cases taken from the services of Drs. L. Chaffin, J. N. Nichols, K. Smiley and the authors have been studied. In the majority of the patients the rectum was found to end blindly at a varying distance from the perineum, the type III anorectal anomaly. The incidence of fistulas and of associated malformations of other systems is relatively higher within this group of cases than in the other types. The mortality and functional results of treatment are about the same in this series as in others of the literature.

The treatment of the type III case with a rectourinary or high rectovaginal fistula has caused prolonged hospitalization and additional mortality by the use of multiple "stage" operations. A one stage primary procedure has consequently been adopted for certain of these patients. This operation the abdominoperineal replacement of the rectum has the advantage of correcting the anal defect and closing the fistula at the same time. The use-



Fig. 8. Roentgenogram of infant with type III imperforate anus at the age of 4 hours, using the Wangenstein and Rice technique. Gas had not entered the pelvic colon sufficiently to localize the rectal pouch. At operation, shortly afterward, the rectosigmoid was found to terminate slightly below the pelvic peritoneal reflexion. A rectourinary fistula was present.

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TABLE I—THROMBIN PRODUCED CLOTS

Experiment No.	Lee-White clotting time in minutes	Prothrombin clotting time in seconds	Prothrombin per cent	Clot present
	8.0	3.0	40.0	Yes
1		.6	53.0	Yes
2	5	11.6	51	Yes
3	7.0	47.0	8	Yes
4	9	7.0	25.5	N
5	14	5.6	5	No
6	9	9.8	23.5	N
7	9	23.5	9.5	N
8	6	2.4	5	N
9	6.5	0	6	Yes
10	5.5	.6	53	Yes
11	4	5.5	7	N
12	14	5.0	1.5	N
13	4.0	9.8	81.0	Yes
14	3.5	16.5	29	N
15	2	43.9	5	N
16	2.5	.3	59	Yes
17	7.5	4	4	Yes
18	6.5	24.7	27.8	N
19	7	7.4	27	N
20	8	14.1	35.5	Yes
21	9.5	22.5	0	N
22	9	6.6	28	Yes
23		.8	30.5	No
24	3	14.9	21.0	N
25	5	3.4	2.5	N
26	6	5	7.5	Yes
27	5	7.9	25.5	No
28	5	7.5	25	Yes
29	7.0	4	45.0	Yes
30	6.5	7	5.0	Yes
31		10	8.0	Yes
32	6	5.5	7	Yes

TABLE II—TRYPSIN PRODUCED CLOTS

Experiment No.	Prothrombin clotting time in seconds	Prothrombin per cent	Clot present
1	30.5	5	No
2	29.0	14	N
3	20.9	21.0	Yes
4	20.5	22.9	Yes
5	20.8	7.6	Yes
6	21.6	5	Yes
7	21.6	0.5	N
8	3		N
9	5.0	20	Yes
10	0.7	69.8	Yes
	7.4	27.0	Yes
12	5.6	25.5	Yes
13	5.4	5	N
14		7.5	Yes
15	14	25	Yes
16	6.6	29	Yes
17	29.2	14	Yes
18	4.0	7.0	Yes
19	20.5	5	Yes
20	26.5	9	Yes
21	20	5	N
22	8	4	Yes

## RESULTS

Isolation of a segment of vein with soft rubber clamps in 8 instances did not produce thrombosis in 15 minutes. Isolation plus the injection of 0.05 cubic centimeter of 0.9 per cent saline in 7 instances produced no thrombosis. Fifty-four veins were used to determine the amount of thrombin necessary to produce coagulation. In 10 radial veins that received 20 units of thrombin clots formed in all. In 14 veins receiving 10 units of thrombin clots were present in 6 or 43 per cent. Forty-seven jugular and femoral veins were used to determine the minimal amount of trypsin necessary to produce thrombosis, less than 0.0001 milligram produced no thrombosis in 6 of 7 instances.

Graphic representations of the results of the injections of thrombin and trypsin in the presence of hypoprothrombinemia may be seen in Figure 2. In the thrombin experiments thrombi were present in 6 veins and were absent in 15 veins when the prothrombin level

from the vein and was immediately absorbed by the sponge. In some instances a small pin point clot was observed at the site of the vein puncture but the remaining blood was completely liquid. Any clot other than this was considered to be a thrombus and is so designated in the tabulated results (Tables I and II). In many instances the character of the clot varied from the controls and this fact will be discussed in more detail.

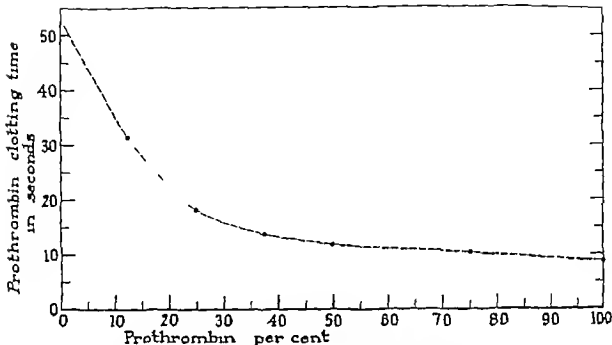


Fig. 1. Calibration curve of plasmas from 9 normal dogs.

ately before each experiment. The calibration curve used is seen in Figure 1.

Dogs were lightly anesthetized with intra venous sodium pentobarbital, 0.44 cubic centil

meter per kilogram of body weight. The anesthetic agent was never injected into the same vein which was used for carrying out the experiment.

Radial veins were used for the thrombin experiments. The external jugular and superficial femoral veins were used for the trypan experiments. The veins were exposed under aseptic conditions and soft rubber clamps were gently applied to isolate a segment 2.5 centimeters in length. Any branch which occasionally entered the isolated segments was ligated with No. 000 silk. The clamps were applied so that the segment was not fully distended with blood in order that excessive distention after the injection of thrombin or trypan would not produce intimal disruption. Immediately after the clamps were applied 0.05 cubic centimeter of either the trypan or thrombin solution was injected through a No. 27 needle into the vein. A gauze sponge was held gently over the site of the needle puncture for 30 seconds. After exactly 15 minutes had elapsed the vein was opened longitudinally. A fresh gauze sponge was placed beneath the vein before the lumen was entered. No thrombus was considered to be present when all the blood flowed

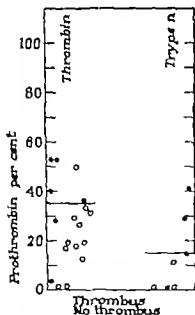


Fig. 2. A graphic representation of thrombosis produced at various levels of hypoprothrombinemia.

# EVALUATION OF HEXACHLOROPHENE AND DETERGENTS AS SUBSTITUTES FOR THE SURGICAL SCRUB

## A Biological Technique

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THE present study was undertaken in order to evaluate some of the newer cleansing and bactericidal agents as possible substitutes for the conventional surgical scrub.<sup>1</sup> A technique which would eliminate much of the time and irritation that are undesirable features of the 10 minute scrub would obviously be worth while. The agents selected for evaluation included a bactericidal agent<sup>2</sup> incorporated in soap, and two detergents.<sup>3,4</sup>

The literature contains several articles on hexachlorophene (1, 7, 8, 9), all giving favorable reports on the use of this agent incorporated in soap for cleansing skin. The techniques utilized by these workers were essentially variations of Price's method for obtaining colony counts from hands and forearms.

In this study animal inoculation was used to evaluate the agents tested. The examination of hand washings by animal inoculation tends to (a) differentiate potentially pathogenic from purely saprophytic organisms, and (b) to eliminate false bactericidal effects of chemicals only bacteriostatic in nature (3, 4).

To establish a maximum standard reaction of animals to pathogenic bacterial infection the method of Nungester, Jourdonais and Wolf (5) of introducing mucin to decrease the resistance of animals to given infection was utilized. Repeated titrations in which a virulent culture of hemolytic streptococci was injected intraperitoneally into mice with and without mucin revealed that the animals' resistance was reduced about one million fold

when mucin was used. Whereas no less than 0.5 milliliter of the culture was lethal to 0.5 milliliter of a  $10^{-6}$  dilution of the same culture when combined with mucin, provided a fatal dose. Strict saprophytes do not kill mice when injected with mucin.

Four series in all were undertaken. The first two were of a preliminary nature and compared a routine surgical scrub with the use of bar soap with a two minute wash with the use of either Duponol phisoderm or hexachlorophene, no brush being used with the last three agents. One of these series was carried on in the hospital, the subjects being physicians actively engaged in clinical work on the surgical wards and in the operating rooms. The series was short and did not contribute any significant comparative results. However, it did reveal the remarkably low pathogenicity of hand rinsings obtained prior to cleansing. The mean mortality of mice injected with hand rinsings obtained prior to cleansing was 18 per cent as against a mean of 13 per cent mortality produced by all the samples taken after cleansing. The results were derived from 12 cleansings with each agent, all agents being tested concurrently. The differences between the improvements resulting from the use of each cleansing agent were not significant.

In the second series physicians engaged in laboratory duties contaminated their hands with 5 milliliters of a hemolytic streptococcal culture before cleansing with the same agent used in the first series as noted previously. Contamination of the hands and wrists was done in order to provide a greater killing power to the rinsings injected and to place a more severe test upon the cleansing and bactericidal properties of the agents tested. As has been noted, the pathogenicity of bacteria usually present on one's hands and forearms

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<sup>1</sup>Control cleansings, as well as surgical scrub, employed bar soap (Ivory).

<sup>2</sup>Hexachlorophene (G-11) Hexachloro-*di*-hydroxy diphenyl methane, 5 per cent incorporated in bar soap of the bar type.

<sup>3</sup>Phisoderm (s) (regular type) containing sodium *t*-octylphenyl ethoxyethyl ether sulfonate.

<sup>4</sup>Duponol (WA paste) 15 per cent in water



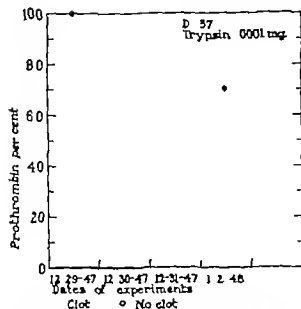


Fig. 3. Thrombosis attempted during the fall and rise of the blood prothrombin level in animal.

was below 35 per cent of normal. When the level was above 35 per cent thrombi were present 11 times and absent once. A more marked reduction in the prothrombin reserve was necessary to inhibit coagulation when trypsin was used. When the prothrombin per cent was below 15 per cent of normal, thrombi were present 6 times and absent on 6 occasions. Above 15 per cent, however, in 10 instances thrombi were always present. Two individual experiments are shown in Figures 3 and 4.

#### COMMENT

The results of the experiments indicate that venous thrombosis produced by a combination of venous stasis and the injection of either thrombin or trypsin may be prevented by reducing the blood prothrombin level. Levels below 35 per cent were necessary in the thrombin induced coagulation and levels below 15 per cent were required to inhibit the trypsin induced thrombosis. It cannot be stated that thrombosis could be inhibited routinely below these levels. On the other hand it can be stated that above these levels, no success was obtained in preventing the formation of thrombi. When coagulation did occur below 35 per cent in the thrombin and 15 per cent in the trypsin experiments

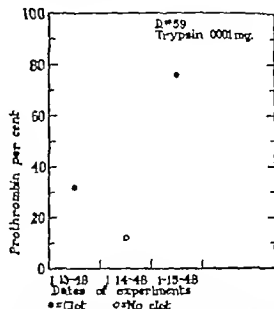


Fig. 4. Thrombosis attempted during the fall and rise of the blood prothrombin level in animal.

the character of the thrombus was different from the controls. Instead of a firm compact thrombus, a loosely adherent mass of fibrin and red cells resembling sludge was encountered.

In clinical practice we have attempted during the past 2 years to maintain the prothrombin level at 20 per cent of normal in the prophylaxis and treatment of venous thrombosis.

#### CONCLUSIONS

- 1 This study suggests that venous thrombi experimentally produced may be prevented by reducing the blood prothrombin level below 35 per cent of normal with dicumarol.
- 2 Blood prothrombin levels above 35 per cent were ineffectual in preventing the formation of thrombi.

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TABLE I.—INTRAPERITONEAL INJECTION, WITH MUCIN OF PEPTONE RINSINGS TAKEN AFTER CLEANSING

Type of cleansing	Hexachlorophene	Routine surgical scrub
No. cleansings	36	48
N mice injected	143	445
No. dead	8	16
Mortality per cent	8.0	3.6

P—less than 4%

Table I presents the data from this series. Results show 12.6 per cent mortality following the use of the 10 minute surgical scrub and 8.0 per cent mortality after a 3 minute wash with soap containing 2 per cent hexachlorophene. This difference is statistically significant.

Their value in decreasing transient streptococci. In this series contamination was done as follows

The skin was contaminated on Monday 5 milliliters of the 10 milliliters in each hemolytic streptococcal culture being placed on the hands of a subject using one agent and the other 5 milliliters being placed on the hands of the subject using the other. On the 4 subsequent days no contamination of hands was done. The rest of the method was precisely as in the previous series. Six subjects participated in this experiment each using both agents with at least 10 days intervening between their use.

These data are presented in Table II. It should be noted that the culture used in these tests was more virulent than the strain of hemolytic streptococcus originally employed. The noteworthy variance is that present in the death rate of the animals injected with rinsings obtained on the first and second days subsequent to the day of contamination. This difference is apparently due to the persistence of the artificially implanted transient bacteria after 3 days of scrubbing whereas there was a rapid depression of the pathogenicity of the rinsings from those subjects employing hexachlorophene bar soap. The difference in mortality on the day after contamination is statistically highly significant. In addition, a similarly significant difference persists on the second day after contamination.

TABLE II.—INTRAPERITONEAL INJECTION WITH MUCIN OF PEPTONE RINSINGS TAKEN AFTER CLEANSING CONTAMINATION WITH 5 C.C. OF STREPTOCOCCUS HEMOLYTICUS CULTURE ON FIRST DAY OF SERIES

	Hexachlorophene 3 minute wash (6 subjects)			Routine surgical scrub 10 minutes (7 subjects)		
	No. of mice injected	Dead	Per cent	No. of mice injected	Dead	Per cent
First day	60	50	83.3	70	60	85.7
Second day	60	7	11.7	70	27	38.6
Third day	60	9	15	70	3	4.3
Fourth day	60	5	8.3	70	0	0
Fifth day	60	8	13.3	70	12	17.1

The possibilities of using hexachlorophene soap for preparing the operative field are apparent. Not only would mechanical cleansing be obtained but the added bactericidal effect would be advantageous. In order to compare the bactericidal effect of hexachlorophene on skin as compared with tincture of iodine, an animal method was used. This was a modification of that used by Kempf and Nungester (4). These authors contaminated a mouse's tail with either a virulent culture of pneumococci or streptococci and, after applying the antiseptic agent to be tested, inserted the amputated tip of the tail into the animal's peritoneal cavity. Our method used the abdominal skin as the test area.

## METHOD

1 Under ether anesthesia the abdomen was shaved and swabbed with a 24 hour blood brain heart broth culture of hemolytic streptococci.

2 After a 1 minute interval as measured by a sand glass, the agent being tested (either tincture of iodine U.S.P. or a 1 per cent solution of the monopotassium salt of hexachlorophene in 33 per cent ethyl alcohol) was blotted on the contaminated area. Care was taken not to wipe away the culture when applying the iodine or hexachlorophene solution.

3 After a measured 2 minute interval a 1 by 0.5 centimeter elliptical segment of skin was removed and the peritoneum opened. The skin segment was placed in peritoneal cavity

is remarkably low and to simulate the usual contamination was undertaken.

In this series, each agent, duponal phisoderm hexachlorophene, and soap and brush was used for 15 cleansings. The data for all agents were obtained concurrently. The results obtained in this second preliminary series again suggested that favorable cleansing could be obtained with either detergent or with hexachlorophene soap as compared with the surgical scrub. The mean mortality of animals injected with rinsings taken after contamination and before cleansing was 79 per cent as compared with a mean mortality following cleansing of 27 per cent for all agents tested. Here again the variations between the agents tested were not significant.

The efficacy of this biological method was well illustrated by data derived from the second preliminary series in which contamination of the hands was done prior to cleansing. Twenty four random autopsies were done on animals that had died after having been injected with samples obtained following cleansing. Cultures from the spleens of these animals revealed hemolytic streptococci in 10 cases whereas, in vitro cultures of the peptone water samples that had been injected into these same 10 animals failed to reveal hemolytic streptococci in 5 instances. There is little doubt that in many instances the abundant overgrowth of bacteria accompanying postmortem changes precluded the identification of hemolytic streptococci. This does not devalue the animal inoculation method as all mice dead following injection provide the critical numbers for statistical analysis whether streptococci are or are not identified in the animals.

As a result of these preliminary experiments, two more series were conducted comparing the routine surgical scrub with a 3 minute brushless wash with soap containing hexachlorophene. In the second of these two series the hands and forearms were contaminated prior to cleansing.

#### PROCEDURE

1 Each subject cleansed with a given agent (10 minute surgical scrub or 3 minute wash with hexachlorophene soap) on each of 5 successive days. The 10 minute surgical scrub

was routine. The 3 minute wash with bar soap containing 2 per cent hexachlorophene involved lathering from fingertips to elbows for 1 minute cleaning fingernails with an orangewood stick for 1 minute while the lather remained on the arms and a third minute was spent relathering the arms and hands, which were then rinsed in running tap water.

2 Each subject rinsed his hands in 200 milliliters of sterile 0.5 per cent peptone water for 1 minute 20 seconds being spent rubbing the palms together 20 seconds rubbing the back of one hand and 20 seconds rubbing the back of the other hand.

3 Immediately thereafter 5 milliliters was taken from each basin of peptone water rinsings and mixed with 5 milliliters of sterile 5 per cent hog gastric mucin. One milliliter of this mixture was then injected intraperitoneally into each of 10 mice. The animals were observed for 5 days and deaths recorded.

In the series in which contamination was done 5 milliliters of a 24 hour blood-brain-heart broth culture were placed in the palms of each subject who then rubbed the culture over all the skin of the hands and wrists. The culture air-dried for 3 minutes after being applied. Such contamination was done prior to cleansing.

#### COMPARISON OF THE SURGICAL SCRUB WITH BRUSHLESS CLEANSING WHEN SOAP CONTAINING 2 PER CENT HEXACHLOROPHENE IS USED

*A statistically significant difference in their cleansing effect on normal skin.* Twelve subjects were used all with scrubbing experience 11 with at least a year's surgical training. After an individual used each agent, at least 10 days intervened before his use of the other agent. The subjects used neither antibacterial agents nor prolonged (i.e., 10 minutes) scrubbing of their hands during this interval. This was to allow the skin flora to be re-established (6) and to remove all hexachlorophene from the skin. Seaton has detected traces of hexachlorophene on the skin 48 hours after exposure to this agent in amounts sufficient to act as a bacteriostatic agent the agent being carried from the hands through the wash water to the culture medium.

TABLE I — INTRAPERITONEAL INJECTION, WITH MUCIN OF PEPTONE RINSINGS TAKEN AFTER CLEANSING

Type of cleansing	Hexachlorophene	Routine surgical scrub
No. cleanings	36	48
No. mice injected	348	448
No. dead	8	86
Mortality, per cent	8	23

P—less than 4%

Table I presents the data from this series. Results show 12.6 per cent mortality following the use of the 10 minute surgical scrub and 8.0 per cent mortality after a 3 minute wash with soap containing 2 per cent hexachlorophene. This difference is statistically significant.

*Their value in decreasing transient streptococci.* In this series contamination was done as follows:

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These data are presented in Table II. It should be noted that the culture used in these tests was more virulent than the strain of hemolytic streptococcus originally employed. The noteworthy variance is that present in the death rate of the animals injected with rinsings obtained on the first and second days subsequent to the day of contamination. This difference is apparently due to the persistence of the artificially implanted transient bacteria after 3 days of scrubbing whereas there was a rapid depression of the pathogenicity of the rinsings from those subjects employing hexachlorophene bar soap. The difference in mortality on the day after contamination is statistically highly significant. In addition a similarly significant difference persists on the second day after contamination.

TABLE II — INTRAPERITONEAL INJECTION WITH MUCIN OF PEPTONE RINSINGS TAKEN AFTER CLEANSING CONTAMINATION WITH 5 C.C. OF STREPTOCOCCUS HEMOLYTICUS CULTURE ON FIRST DAY OF SERIES

	Hexachlorophene 3 minute wash (6 subjects)			Routine surgical scrub 10 minutes (7 subjects)		
	No. of mice injected	Dead	Per cent	No. of mice injected	Dead	Per cent
First day	60	39	65.5	70	69	97
Second day	60	7	11.7	70	87	124.6
Third day	60	0	15	70	32	45.7
Fourth day	60	5	15	70	0	15
Fifth day	60	8	16	70	12	17

The possibilities of using hexachlorophene soap for preparing the operative field are apparent. Not only would mechanical cleansing be obtained but the added bactericidal effect would be advantageous. In order to compare the bactericidal effect of hexachlorophene on skin as compared with tincture of iodine an animal method was used. This was a modification of that used by Kempf and Nungester (4). These authors contaminated a mouse's tail with either a virulent culture of pneumococci or streptococci and, after applying the antiseptic agent to be tested, inserted the amputated tip of the tail into the animal's peritoneal cavity. Our method used the abdominal skin as the test area.

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3 After a measured 2 minute interval a 1 by 0.5 centimeter elliptical segment of skin was removed and the peritoneum opened. The skin segment was placed in peritoneal cavity

TABLE III.—RESULTS

	No animals	Deaths	Mortality per cent
Iodine	36	3	8.3
Hexachlorophene	30	44	67
Control	16	3	25

4. Five-tenths milliliter of sterile mucin was injected intraperitoneally and the wound then closed with cotton sutures.

These animals were observed for 5 days and deaths recorded. A control series was conducted concurrently in which the method was identical except for the application of iodine or hexachlorophene. Table III presents the results of this experiment.

The 42 per cent mortality is similar to that obtained by Kempf and Nungester in their tests in which the animals' tails were used to carry the culture and agent into the peritoneal cavity. Their mortality was 38 per cent when iodine was used and from 85 to 95 per cent when mercuric iodine or phenol was used. These agents were not compared directly in our experiment.

#### DISCUSSION

These experiments substantiate our recommendation that the routine surgical scrub be eliminated in favor of a 3 minute wash with soap containing hexachlorophene. Such a change is desirable because of the common irritating effects resulting from repeated cleansing with a brush. The low pathogenicity of the skin flora from the hands and forearms is noteworthy. This is indicated by an 18 per cent mortality of mice injected with mucin and skin washings obtained prior to cleansing.

It should be noted that no alcohol rinse was employed in these tests. Attention is drawn to Seaton's statement that the use of an alcohol rinse after cleansing may extract part of the hexachlorophene from the skin.

In conducting this work an attempt was

made to obtain subjective criticism of the different agents being evaluated. Several subjects found duponol somewhat drying and irritating to the skin although no definite sensitivity was noted objectively. Phisoderm was well received, as was the bar soap containing hexachlorophene. No instances of sensitivity to either were observed.

Although data are not sufficient to draw fixed conclusions on the basis of preliminary experiments cleansing with phisoderm (s) and duponol would also appear to have possibilities as substitutes for the surgical scrub. A combination of a detergent and hexachlorophene might be efficacious. In addition use of these agents for preparing the operative field is suggested.

#### SUMMARY

1. A biologic method for evaluation of agents for cleansing the skin is presented. This technique differentiates the bacteriostatic and bactericidal action of chemicals. The use of animals whose species resistance has been greatly lowered by injection of mucin also serves to determine the potential virulence of skin flora.

2. Under the conditions of these experiments it may be concluded that the use of bar soap containing 2 per cent hexachlorophene for 3 minutes without a brush is superior to the routine two brush, 10 minute surgical scrub.

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# TENDON TRANSPLANTS FOR IRREPARABLE RADIAL NERVE PARALYSIS

CARLO SCUDERI M.D., Ph.D. F.A.C.S., Chicago, Illinois

THE present paper is based on the personal experience of the author as Chief of Orthopedic Surgery and later as Chief of the Surgical Service while at McGuire General Hospital Richmond, Virginia.

In all 45 cases of tendon transplantation for irreparable radial nerve paralysis were carried out by the author from February 27, 1945 to March 9, 1946. Various operative procedures were used and a clinical evaluation of the procedure made at the time that the patient was being either separated from the Service or transferred to another installation.

## REVIEW OF LITERATURE

Operative attempts for the restitution of function by tendon transplants in radial nerve paralysis date back over 50 years.

In 1896 Drobniak did a transplant for the paralysis of the posterior branch of the radial nerve with conservation of the function of the extensor carpi radialis longus. The extensor carpi radialis longus was placed into the common extensors of the fingers.

In 1897 Rochet had a case of partial paralysis of the radial nerve with persistence of function of the extensor carpi radialis longus which was transplanted into the extensor pollicis longus and extensor indicis proprius.

In 1902, Cappelli did a shortening of the extensor carpi radialis longus and transplantation of the flexor carpi ulnaris into the common extensors of the fingers and of the palmaris longus into the extensor indicis proprius.

From the end of the nineteenth century to World War I sporadic case reports and questionable procedures appeared in the literature. In 1917 Sir Robert Jones standardized his operation of tendon transplants for radial nerve paralysis and firmly established a milestone in the method of treatment of this condition. He transplanted the pronator teres into the extensor carpi radialis longus, the flexor carpi

radialis into the extensor pollicis longus and the extensor indicis proprius, and the flexor carpi ulnaris into the extensor tendons of the third, fourth, and fifth fingers.

In civilian life injuries which are of the type to produce irreparable radial nerve paralysis are few and far between. Consequently in the intervening period between World War I and World War II, the only report of a number of cases seen by any one surgeon or any one clinic was from the Mayo Clinic where 23 cases were treated over a period of 26 years. This article written by Young and Lowe gave an excellent review of a long term follow up of patients.

Bonola, in 1936 presented an excellent review of the subject and also an ingenious method of evaluating these cases from a functional standpoint.

During World War II, due to the kind of warfare with previously unknown types of high velocity shells, land mines, and aerial bombs, the injuries to the extremities reached astronomical figures. Consequently, in a relatively short period of time a substantial number of injuries of this type gravitated to specialized centers.

In 1946 Altman and Trott reported on 28 cases from McCloskey General Hospital, in this country, and Zachary reported on 57 cases from Wingfield Morris Hospital in England. These cases were done by various surgeons on the staff.

Lamphier and Littler, in 1947 reported on an undisclosed number of the cases performed at Cushing General Hospital. The procedure they used was the transference of the flexor carpi radialis into the abductor pollicis longus, extensor pollicis longus and brevis, and of the flexor carpi ulnaris into the common extensor tendons to the fingers.

In cases reported by Altman and Trott the pronator teres was inserted into the extensor carpi radialis longus and brevis, the flexor

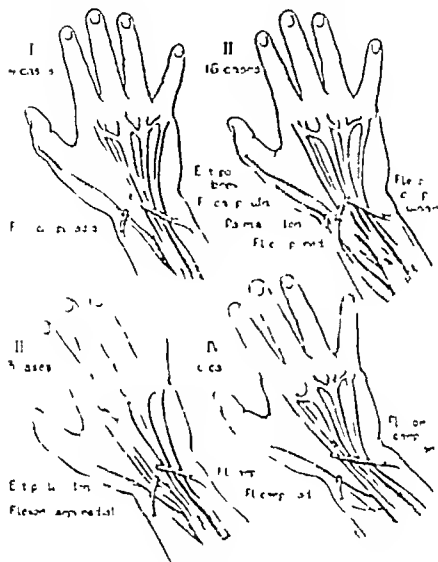


Fig. The four common types of tendon transplant performed in the writer's series are graphically shown in I, II, III, and IV. The number of each type of operation performed is indicated in the accompanying table.

carpi radialis into the extensor pollicis longus and brevis and the flexor carpi ulnaris into all the extensor tendons of the fingers. They reported uniformly good results in their cases.

In most of the cases reported by Zachary, the pronator teres was transplanted into the extensor carpi radialis longus, the flexor carpi ulnaris into the extensor tendons of the third, fourth, and fifth fingers, and the flexor carpi radialis into the extensor pollicis longus and extensor indicis proprius. In a careful analysis of these cases, he brought out a very im-

portant point with which the writer was able to concur. He noted that if all the flexors of the wrist (flexor carpi ulnaris, flexor carpi radialis, and palmaris longus) were transferred, stabilization of the wrist was lost in many instances and often led to incomplete extension of fingers and unnecessary weakening or abolishment of voluntary power of wrist flexion.

#### REPORT OF PERSONAL CASES

Various methods of tendon transplants were used in this series and careful after studies

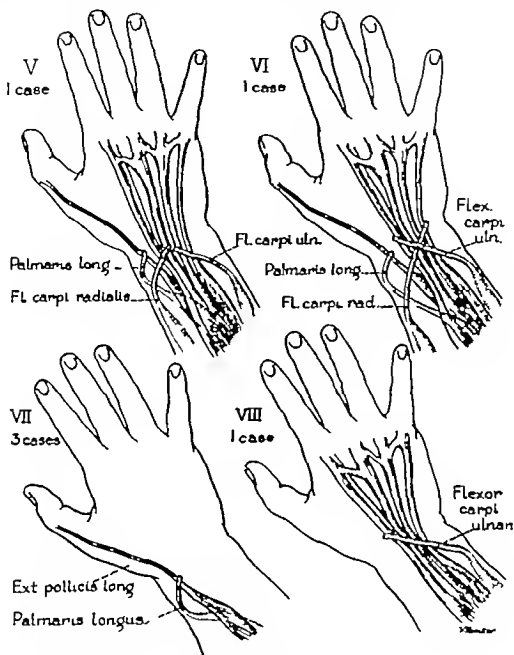


Fig. 1b. The less common types of tendon transplants performed in this series are graphically shown in illustrations V, VI, VII, and VIII. This group consists of 6 cases.

were made in order to evaluate their relative efficiency.

Forty five cases were carried out in all. The various types of transplants are presented in Table I and in Figures 1a and 1b.

The study of these patients during the convalescent periods and the analysis of many of the cases by means of movies revealed the following:

1 Combined suture of one transplanted tendon into two or more inactive tendons having different functions (such as suturing

the *palmaris longus* or the *flexor carpi radialis* into the *extensor pollicis longus* and *brevis* or *extensor pollicis longus* and *extensor indicis proprius*) was not as satisfactory as transference into a single thumb tendon.

2 In spite of experimental evidence to the contrary, the *flexor carpi ulnaris* muscle is perfectly capable of extending the wrist and all the fingers, if properly sutured under the correct amount of tension. (Sudeck, in 1944 stated that the working power of the *flexor carpi ulnaris* was 2 kgm and that this was



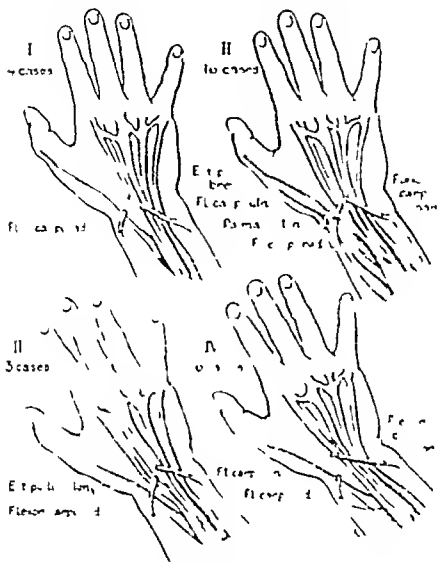


FIG. The most common types of tendon transfers. I, II, III, IV. The transfer of the type I operation performed by the writer for the Parry-Romberg.

carpi radialis into the extensor pollicis longus and brevis and the flexor carpi ulnaris into all the extensor tendons of the fingers. They reported uniformly good results in their cases.

In most of the cases reported by Zachary, the pronator teres was transplanted into the extensor carpi radialis longus, the flexor carpi ulnaris into the extensor tendons of the third, fourth, and fifth fingers, and the flexor carpi radialis into the extensor pollicis longus and extensor indicis proprius. In a careful analysis of these cases, he brought out a very im-

portant point, with which the writer was able to concur. He noted that if all the flexors of the wrist, flexor carpi ulnaris, flexor carpi radialis and palmaris longus were transferred, stabilization of the wrist was lost in many instances and often led to incomplete extension of fingers and unnecessary weakening or abolishment of voluntary power of wrist flexion.

#### REPORT OF PERSONAL CASES

Various methods of tendon transplants were used in this series and careful after studies

elbow and the extremity washed thoroughly with soap and water. After 10 minutes of good washing with frequent changes of water, alcohol and ether are poured over the part and sterile towels are then placed around the arm from the finger tips to the elbow.

The day of surgery when the patient is on the operating table the extremity is again washed with soap and water then drenched with alcohol and ether. A sterile towel is now placed over the field and the arm elevated. All of the blood is squeezed out of the arm by the use of a Martin constrictor to the upper arm where a blood pressure cuff is pumped up to 300 millimeters of mercury to insure hemostasis. The Martin constrictor is then removed. This leaves a bloodless extremity to be worked upon, gives excellent visibility, is a great time saver and avoids the unnecessary trauma to exposed tendons and their sheaths from repeated sponging.

The field is now prepared with one of the standard operating room antiseptics.

The insertions of the palmaris longus, flexor carpi radialis and flexor carpi ulnaris are easily identified by extension of the wrist. Short longitudinal incisions are made the tendon isolated and then cut free. By pulling gently on the cut tendon, its proximal portion can be palpated in the forearm, 6 to 8 inches proximally, and then through individual short longitudinal incisions each tendon is exposed. The tendon is then drawn from the distal end proximally so that it is freed through the proximal incision. The flexor carpi ulnaris has a very low attachment of muscle fibers frequently down to the last one-half inch of the tendon. The muscle should be sufficiently removed so that about 3 inches of the tendon is free of muscle in order to permit better suture into the recipient tendons and also to provide for better gliding between the subcutaneous fat on one side and the fascia of the arm on the other side.

The hand and forearm are then pronated and the extensor pollicis longus tendon isolated in the "anatomical snuff box." It is completely severed at the level of the distal end of the radius. It is most important that this tendon be accurately identified before it is severed. Retraction of the proper tendon

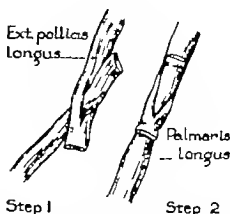


Fig. 2. The buttonhole technique for the suture of the palmaris longus to the extensor pollicis longus was most satisfactory in the author's experience. Step 1 a slit is made in the extensor pollicis longus just distal to the cut end, and the palmaris longus tendon is drawn through the slit. Step 2, four silk sutures are then used to hold the tendons together. This type of anastomosis is simple, effective, and rapidly performed.

produces extension of the terminal phalanx of the thumb.

A well known principle of tendon transplantation must be kept in mind at this stage of the procedure. A transplanted tendon and muscle will work most efficiently if its action is in a straight line running from the origin of the motor muscle to the insertion of the recipient tendon. Any sharp curves or angulations decrease or completely defeat the transplanted motorized unit. For this reason the author has always attempted to attach the transplanted tendons as far distally as possible. This by necessity required the exposure of the common extensor tendons at the level of the dorsal carpal ligament. This overlying portion of the ligament was routinely removed, so that the anastomosis of the tendons was given the smooth gliding anterior portion of the ligament on the anterior aspect and the abundant subcutaneous fat on the posterior aspect. On no occasion were any adhesions detected in this area nor was there ever seen any posterior or mediolateral displacement of the extensor communis tendons. A number of men have recommended that the tendon anastomosis always be done proximal to the dorsal carpal ligament. This procedure angulates the transplanted tendon and thereby decreases its mechanical efficiency. All of the transplanted tendons are tunneled between the fascia of the forearm on one side and the

TABLE I

Transplanted tendons	Recipient tendons	N. of cases
I. Flexor carpi radialis Flexor carpi ulnaris	Extensor pollicis longus Common extensor tendons of fingers	4
II. Flexor carpi radialis Flexor carpi ulnaris Palmaris longus	Extensor pollicis longus Extensor indicis proprius Extensor tendons of the third, fourth and fifth fingers Extensor pollicis brevis	6
III. Flexor carpi radialis Flexor carpi ulnaris	Extensor pollicis longus Extensor indicis proprius Extensor tendons of third, fourth and fifth fingers	3
IV. Flexor carpi ulnaris Palmaris longus	Extensor tendons of second, third, fourth, and fifth fingers Extensor pollicis longus	16
V. Flexor carpi radialis Flexor carpi ulnaris Palmaris longus	Emergency tendons of second, third fingers Extensor tendons of fourth and fifth fingers Extensor pollicis longus	
VI. Flexor carpi radialis Flexor carpi ulnaris Palmaris longus	Extensor tendons of second, third, fourth, and fifth fingers Extensor tendons of second, third, fourth and fifth fingers operations performed—muscular case Extensor pollicis longus	
VII. Palmaris longus (Paralysis of extensor and abductor tendons of the thumb)	Extensor pollicis longus	3
VIII. Flexor carpi ulnaris (Thumb muscles were normal—paralysed radial nerve paralysis)	Extensor tendons of second, third, fourth and fifth fingers	
Total cases		41

sufficient only for extending the digits, as 4 to 5 kgrs. of power were required to extend the wrist as well as the digits.)

3. It is most important that the transplanted tendons run in as straight a line as possible from the origin of the muscle to the insertion of the recipient tendon. Acute angles or long sweeping curves of the transplanted tendons decrease their efficiency.

4. The complete severance of the extensor pollicis longus tendon in the 'anatomical snuff box' and the swinging of the loose end anteriorly then suturing it to the transferred palmaris longus tendon gives a most excellent combined extensor and abductor motion to the thumb. In fact it is almost impossible to distinguish the result from the normal thumb function. This observation was accidentally discovered in 1 case as a result of severance of the palmaris longus tendon a little too proximal to its insertion so that it was relatively short and could not reach the extensor pollicis longus tendon in its normal location.

5. Although the transplantation of the flexor carpi radialis into the extensor pollicis longus and extensor indicis proprius, and the flexor carpi ulnaris to the extensor tendons of the third, fourth and fifth fingers gives a wide opening of the thumb and fingers in the extended position, it weakens and in some cases abolishes voluntary flexion of the wrist if the palmaris longus tendon is absent. When the palmaris longus tendon is present (absent in 3 of the 45 cases) it motorizes the thumb very well if sutured to the severed extensor pollicis longus tendon as described previously.

6. All of the tendon transferences done in this series produced marked improvement of the function of the hand regardless of what minor detail of tendon to tendon transference was performed. Only 1 case was considered as a complete failure. Whether or not it was a surgical or psychosomatic failure will probably never be definitely known. This was the case of an officer who did not desire to be separated from the Service until the September semester of college began the following year. He was operated upon July 19 1945. It was impossible to get his co-operation in physiotherapy and occupational therapy postoperatively. A second operation was performed on January 31 1946 for a second tendon transference. By that time such marked fibrosis had resulted in the fingers that the case was ultimately classed as a failure.

#### PREOPERATIVE CARE

Unless the wrist, fingers, and thumb have free joint motion, the surgeon is handicapped before he starts. It is most important that the hand receive intensive physical therapy in the form of whirlpool baths, heat, and massage until all the joints are freely movable, and the skin soft and pliable. If adhesions of the joints exist prior to surgery it will be almost impossible to correct the joint limitation after surgery. None of the patients in this series were operated upon until the fist could be firmly made actively and full extension of the fingers and thumb was possible, passively.

#### OPERATIVE TECHNIQUE

The day prior to surgery the finger nails are cut short, the hand and arm shaved up to the

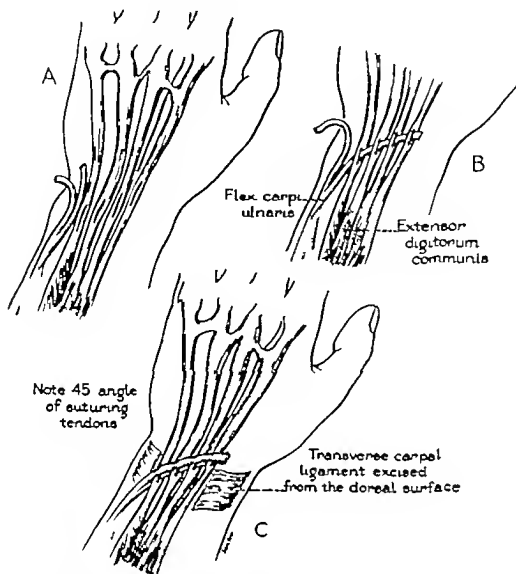


Fig 3. A, Shows the buttonholing of each extensor tendon at an angle of 45 degrees so that the tendon to the little finger has the most proximal buttonhole and the extensor tendon to the index finger has the most distal slit. B, The flexor carpi ulnaris tendon is slit longitudinally, and half of the tendon is threaded through the buttonhole slits and sutured in place. C, The transverse carpal ligament is completely excised, and the remaining half of the flexor carpi ulnaris tendon is sutured over the top of the tendons. This gives excellent security of the suture line.

#### POSTOPERATIVE CARE

The postoperative care of these patients is most important. Immobilization in plaster for 16 to 18 days postoperatively is necessary in order to insure good healing of the tendons and also to prevent excessive formation of scar tissue. Earlier immobilization of the tendons produces more adhesions and scar tissue. This was shown experimentally by Mason and Allen.

A cast is used extending from the proximal interphalangeal joint to the elbow with the wrist in the cock up position and the thumb in the mid abduction extension position.

At the end of 16 to 18 days physical therapy is begun. This consists of muscle re-education whirlpool baths heat and gentle massage. The importance of daily physical therapy by a competent therapist cannot be over emphasized. The individual gains confidence easily muscle re-education becomes simplified normal interphalangeal and metacarpophalangeal motion is maintained and a shorter convalescence results.

At the end of 4 weeks from the date of operation occupational therapy should be instituted. Graduated types of work from the sim

subcutaneous fat on the more exterior side. This gives an excellent gliding mechanism.

In 20 cases of this series the flexor carpi ulnaris was sutured to all of the common extensor tendons. It was found to be an efficient motorized unit provided that a few points were carefully adhered to.

The flexor carpi ulnaris tendon works best if the anastomosis to the common extensor tendons of the fingers is done so the tendon to the little finger is sutured approximately  $\frac{3}{4}$  inch proximal to the suture of the tendon to the index finger. In this fashion the same amount of extension tension could be placed on all of the extensor tendons. The ring and middle finger tendons are anastomosed between the index and little finger tendons so that they maintain the same angle of suturing (the middle finger tendon being sutured  $\frac{3}{4}$  inch distal to the level where the ring finger was being sutured (Fig. 2).

The amount of tension necessary for adequate function is very difficult to determine. Experience is the best teacher. If too much tension is used the wrist cannot be adequately flexed. If not enough tension is used dorsiflexion of the wrist is inadequate.

In none of the cases treated in this series was any ulnar deviation of the wrist noted when extension was initiated by the flexor carpi ulnaris muscle.

When the flexor carpi radialis is used it is drawn subcutaneously around the radius and inserted into the desired thumb or index tendon. The same principles apply to this tendon as to the flexor carpi ulnaris.

After it was once discovered that if the extensor pollicis longus tendon was severed at the 'anatomical snuff box' and drawn anteriorly and anastomosed to the palmaris longus giving an excellent combined thumb function of extension and abduction the procedure alone was used for the rehabilitation of the thumb. In 3 cases of this series the palmaris longus was absent and then the flexor carpi radialis was used.

At the completion of this anastomosis, the line of action must be straight from the origin of the palmaris longus muscle to the insertion of the extensor pollicis longus tendon into the terminal phalanx of the thumb.

It was the author's experience that combined anastomosis into the extensor pollicis longus or brevis, and abductor pollicis longus or any combination of anastomosis of these tendons to a single motorized transplanted unit, decreased the efficiency of the unit considerably. Combined pulls of two or more tendons on the thumb do not work as efficiently because each tendon has a slightly different line of pull and besides has a different amplitude of movement to produce a desired motion of a digit. This point has been well brought out by Bunnell.

Various methods of anastomosis of the tendons were tried. The anastomosis giving the maximum holding power with the fewest number of stitches is by necessity the one desired. The final type of standardized anastomosis used in this series is as follows.

In anastomosing the palmaris longus tendon into the severed extensor pollicis longus tendon the buttonhole technique is used. A small slit is made through the extensor pollicis longus tendon near its severed end, and the palmaris longus tendon is drawn through this opening. The tendons are then sutured to one another by two sutures at the end of each tendon making a side-to-side anastomosis (Fig. 2).

When the anastomosis is made for the flexor carpi ulnaris or radialis, the recipient tendons are buttonholed at the desired level for the anastomosis and a straight Kelly forceps is inserted through all the buttonholes. The motorized tendon is then slit longitudinally and half of it is drawn through the recipient tendons with the forceps. Two interrupted silk sutures are used to fix each tendon. The other half of the slit motorized tendon is then laid over its other half and sutured in place with only two silk sutures at the proximal and distal end of the anastomosis. This gives an excellent mechanical anastomosis with a minimal number of stitches. On one occasion it was necessary to reopen this type of anastomosis in order to put more tension on the motorized tendon. The inspection of the anastomosis showed no excessive scar tissue production, and the anastomosis was covered with what appeared to be a normal tendon sheath (Fig. 3).

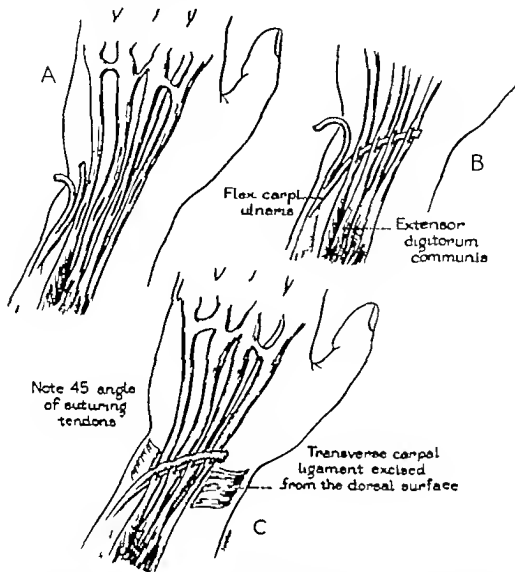


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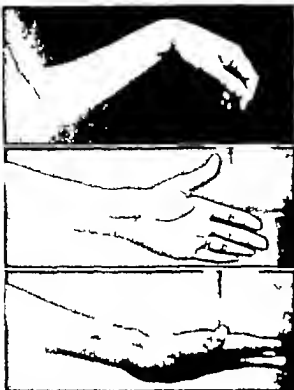


Fig. 4, box. Preoperative film of drop fist following an irreparable radial nerve paralysis. The fingers cannot be voluntarily extended, nor can the thumb be abducted or extended.

Fig. 5, center. The postoperative motions of the thumb 3 months after the palmaris longus tendon is sutured to the severed extensor pollicis longus tendon. Full abduction-extension motion is now possible.

Fig. 6, below. The postoperative motion of the fingers in the same case. The flexor carpi ulnaris is sutured to all the common extensor tendons of the fingers. Note the marked hypertrophy of the palmaris longus tendon running to the thumb.

ple to the complicated and from the light to the heavy should be carried out. By the aid of a good occupational therapist the muscular hypertrophy and the co-ordination of the wrist fingers and thumb improves. Usually if the patient is co-operative a relatively good hand results in about 3 to 4 months from the date of surgery (Figs. 4, 5, 6). In most cases improvement reaches its peak within a period of approximately 9 months. In a few cases which were performed prior to World War II in civilian practice and which were observed for a few years thereafter the improvement was very little if any after the initial 9 months period.

## CONCLUSIONS

1 The transplantation of the palmaris longus tendon into the severed extensor pollicis longus tendon gives an excellent result of abduction-extension power to the thumb. It is most important that the pull of the palmaris longus be in a straight line from the origin of the palmaris longus to the insertion of the extensor pollicis longus tendon into the terminal phalanx of the thumb.

2 The transference of the flexor carpi ulnaris into the extensor tendons of the second, third, fourth and fifth fingers gives good finger and wrist extension. The flexor carpi ulnaris must be sutured at a 45 degree angle to the long axis of the extensor tendons, so that the anastomosis to the extensor tendon of the second finger is about  $\frac{3}{4}$  to 1 inch distal to the anastomosis to the extensor tendon of the fifth finger.

The use of the flexor carpi radialis into one of the thumb tendons and the extensor tendon of the index finger is not advocated unless there is an absence of the palmaris longus tendon. Its transference in addition to the flexor carpi ulnaris and the palmaris longus tendons weakens or abolishes voluntary wrist flexion, weakens the stabilization of the wrist so that complete extension of the fingers is difficult, prolongs the operative procedure and adds an unnecessary additional operative risk.

3 The transplanted tendon must exert its pull in as straight a line as possible from the origin of the muscle to the insertion of the recipient tendon. Sharp angles or curves decrease the efficiency of the motorized unit.

4 The transplantation of a single tendon into the extensor pollicis longus is far more efficient than transplantation of a single tendon into two or more thumb or thumb and index finger tendons. Variation of amplitude of each tendon to perform its normal function and the difference of the line of pull correspondingly decrease the efficiency of the unit.

5 Preoperative physical therapy must be carried out until complete range of motion is possible in the interphalangeal and metacarpophalangeal joints of the thumb and fingers. The flexion motion can be performed actively while the extension motions of the fingers and the abduction-extension movements of the

thumb can of course be performed only passively

*Transplanted tendons are unable to overcome the restricted movements which are the result of perarticular adhesions of the joints* Time spent in preoperative physical therapy pays the greatest dividends and enhances the chances for success in this procedure

6 Postoperative physical therapy and later occupational therapy of increased gradation of amplitude and stress shorten the convalescence Muscle hypertrophy is quicker coordination of fingers and thumb motions are learned in less time and the morale of the patient is kept at its highest level

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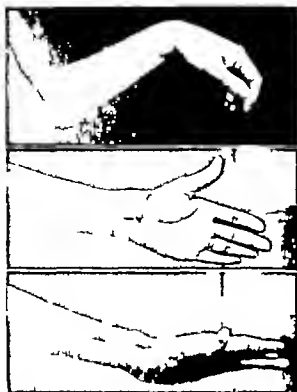


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# RUPTURED UTERUS

## A Report of 42 Cases

J. E. FITZGERALD, M.D. and AUGUSTA WEBSTER, M.D. F.A.C.S., Chicago, Illinois, and  
J. E. FIELDS, M.D. Joliet, Illinois

**D**URING the 20 years from 1928 to 1947 inclusive there were 42 instances of ruptured uteri at the Cook County Hospital. In this same period 92,226 women were delivered of viable infants. Although rupture of the uterus is rare, it carries an exceedingly high mortality for both mother and baby and therefore the subject seems worthy of review.

In the present series there were 23 maternal deaths or a maternal mortality of 54.76 per cent. The fetal mortality was 79.07 per cent—28 stillborn infants, 1 neonatal death and 5 infants who died in utero undelivered. Nine infants lived a fetal saving of only 20.93 per cent.

In 16 cases the uterus ruptured before the women were brought to the hospital and in 26 instances the rupture occurred in the Cook County Hospital. Twenty-two of the mothers were white and 20 were negro.

Table I shows the distribution as to ages. It will be noted that the largest number of cases was in the age group of 36 to 40 years, inclusive and the next largest in the 21 to 25 year age group.

Thirty-eight ruptures were in multiparous and 4 ruptures were in nulliparous women (Table II).

The individual circumstances vary so much as to etiology, symptoms, degree of shock, diagnosis, and treatment that it is almost impossible to make graphs of any value. We are therefore stating briefly the salient facts in each case. An effort has been made to group the abstracts as to etiology.

In 9 cases rupture occurred following previous cesarean section. In the first 7 reported rupture occurred after previous classical sec-

tions and in Cases 8 and 9 after low cervical sections. (In patients 6 and 8 the original sections were performed at the Cook County Hospital.)

**CASE 1 (1933)** White secundipara, tertigravida, aged 31 years, at term, cephalic presentation. Bag of waters was intact. The patient had been in labor for 11 hours progressing normally to 7 centimeters and station plus 2 when she suddenly grabbed her abdomen and cried out "I'm tearing." Profound shock ensued. Supravaginal hysterectomy was immediately performed and a transfusion of 1,000 cubic centimeters of blood given. She died of peritonitis on the 11th day after operation. The infant was stillborn.

**CASE 2 (1933)** White secundipara, tertigravida, aged 32 years, 38 weeks gestation, cephalic presentation. The patient was admitted in mild shock, not in labor. Bag of waters was intact. She had sudden severe constant abdominal pain with marked tenderness over scar and easily palpable fetal parts. Blood transfusion was followed by prompt hysterectomy. Recovery was uneventful. She returned home on the 16th day after operation. The infant was stillborn.

**CASE 3 (1940)** White primipara, secundigravida, aged 9 years, 38 weeks gestation, cephalic presen-

TABLE I—AGE

No. cases	% cases
3	Under 20
	5
3	20-30
7	31-40
6	41-50

TABLE II

No. of cases	Para
4	2
6	3
3	4
8	5
4	6
4	7
3	8
	9

From the Department of Obstetrics, Cook County Hospital, and the Department of Obstetrics and Gynecology, Northwestern University Medical School.

tation. The patient was admitted in early labor and mild shock. Bag of waters was intact. She had marked tenderness over the old scar and fetal parts were easily palpable. Supracervical hysterectomy was performed and a transfusion of 1000 cubic centimeters of blood was given in the operating room. The patient recovered after a stormy postoperative course. The infant was stillborn at 8½ months.

**CASE 4 (1941)** Colored primipara secundigravida, aged 21 years 38 weeks gestation cephalic presentation. The patient was admitted in severe shock, not in labor. Bag of waters was intact. During routine visit to prenatal clinic, she had suddenly developed acute pain over an old incision and was hospitalized at once. The infant was removed from the uterine cavity and hysterectomy performed. The patient recovered. The infant lived.

**CASE 5 (1946)** Colored primipara tertigravida, aged 32 years at term cephalic presentation. The patient entered the hospital in good condition in mild labor for 3 hours. Bag of waters was intact. There were no symptoms of rupture but tear was discovered during laparotomy. Porro section was performed for rupture in upper uterine segment. Penicillin and blood were given postoperatively. The patient recovered and was discharged from the hospital on the 12th day after operation. The infant lived.

**CASE 6 (1944)** Colored tertipara, quadrigravida, aged 30 years 30 weeks gestation. The patient was admitted in severe shock with cramps and pains of 7½ hours duration. She had believed herself to have indigestion for which she had taken castor oil. Sudden sharp abdominal pain followed (Fig 1). Immediate hysterectomy was performed and blood and plasma transfusions were given. The patient recovered and returned home on the 17th day after operation. The infant was stillborn.

**CASE 7 (1928)** White primipara, secundigravida, aged 21 years 34 weeks gestation. The patient was admitted in good condition in early labor with a history of previous classical section for generally contracted pelvis. Bag of waters intact. Dilatation was 2 centimeters station minus 4. Preparations were completed for a repeat section but the patient refused surgery. The uterus ruptured 8½ hours after admission. Laparotomy was carried out immediately after rupture with the patient in poor condition. The patient died during surgery. Baby and placenta were in the peritoneal cavity, there was a 15 centimeter separation of the fundus with smooth edges. The infant was stillborn.

**CASE 8 (1934)** Colored primipara, secundigravida, aged 16 years at term breech presentation. The patient was admitted in mild labor with fetal heart tones present until bag of waters ruptured. Labor pains ceased and were replaced by a steady, not severe pain which increased in severity in the lower abdomen near the old scar. As soon as the pain became severe laparotomy was done and hysterectomy performed. The patient recovered and returned



Fig. 1. Case 6. Tear at site of old section scar. Note smooth edges.

home on the 12th day after operation. The infant was stillborn.

**CASE 9 (1942)** Colored quadripara quintigravida, aged 22 years, at term cephalic presentation. The patient was admitted in mild labor, bag of waters was intact, fetal heart tones were present. There were no symptoms of rupture. During repeat cesarean section a 2½ centimeter tear in the lower uterine segment was found with the bag of waters bulging through. The section was completed, the uterus resutured and the patient sterilized. The patient recovered. The infant lived.

Of these patients who had undergone previous cesarean section 6 were in labor and 3 were not upon admission. Two of the patients had such mild symptoms that the rupture of the old scar was not suspected (Cases 5 and 9) but was discovered at the operating table at the time of repeat section.

Six uteri ruptured with transverse presentation.

**CASE 10 (1930)** White quadripara quintigravida, aged 38 years. The patient was admitted with the bag of waters ruptured and hand and cord prolapsed. The duration of labor was unknown, fetal heart tones were absent. Delivery was accomplished by decapitation, the fetal trunk was removed and the head

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**CASE 2 (1933)** White secundipara, tertigravida, aged 32 years, 38 weeks gestation, cephalic presentation. The patient was admitted in mild shock, not in labor. Bag of waters was intact. She had sudden severe constant abdominal pain with marked tenderness over scar and easily palpable fetal parts. Blood transfusion was followed by prompt hysterectomy. Recovery was uneventful. She returned home on the 16th day after operation. The infant was stillborn.

**CASE 3 (1910)** White primipara, secundigravida, aged 19 years, 38 weeks gestation, cephalic pre-

TABLE I—AGE

No. cases	Years
3	Under 20
	3
5	20-30
7	31-35
6	36-40
	Over 40

TABLE II

No. of cases	Part
4	
6	
1	2
8	3
4	4
6	5
4	6
	7
3	8
	9
2	

From the Department of Obstetrics, Cook County Hospital, and the Department of Obstetrics and Gynecology, Northwestern University Medical School.

tation. The patient was admitted in early labor and mild shock. Bag of waters was intact. She had marked tenderness over the old scar and fetal parts were easily palpable. Supracervical hysterectomy was performed and a transfusion of 1000 cubic centimeters of blood was given in the operating room. The patient recovered after a stormy post-operative course. The infant was stillborn at 8½ months.

**CASE 4 (1941)** Colored primipara, secundigravida, aged 21 years, 38 weeks gestation, cephalic presentation. The patient was admitted in severe shock, not in labor. Bag of waters was intact. During routine visit to prenatal clinic, she had suddenly developed acute pain over an old incision and was hospitalized at once. The infant was removed from the uterine cavity and hysterectomy performed. The patient recovered. The infant lived.

**CASE 5 (1946)** Colored primipara, tertigravida, aged 32 years, at term, cephalic presentation. The patient entered the hospital in good condition in mild labor for 3 hours. Bag of waters was intact. There were no symptoms of rupture but tear was discovered during laparotomy. Porro section was performed for rupture in upper uterine segment. Penicillin and blood were given postoperatively. The patient recovered and was discharged from the hospital on the 12th day after operation. The infant lived.

**CASE 6 (1944)** Colored tertipara, quadrigravida, aged 30 years, 30 weeks gestation. The patient was admitted in severe shock with cramps and pains of 7½ hours duration. She had believed herself to have indigestion for which she had taken castor oil. Sudden sharp abdominal pain followed (Fig. 1). Immediate hysterectomy was performed, and blood and plasma transfusions were given. The patient recovered and returned home on the 17th day after operation. The infant was stillborn.

**CASE 7 (1928)** White primipara, secundigravida, aged 21 years, 34 weeks gestation. The patient was admitted in good condition in early labor with a history of previous classical section for generally contracted pelvis. Bag of waters intact. Dilatation was 2 centimeters station minus 4. Preparations were completed for a repeat section but the patient refused surgery. The uterus ruptured 8½ hours after admission. Laparotomy was carried out immediately after rupture with the patient in poor condition. The patient died during surgery. Baby and placenta were in the peritoneal cavity; there was a 15 centimeter separation of the fundus with smooth edges. The infant was stillborn.

**CASE 8 (1934)** Colored primipara, secundigravida, aged 16 years, at term, breech presentation. The patient was admitted in mild labor with fetal heart tones present until bag of waters ruptured. Labor pains ceased and were replaced by a steady, not severe pain which increased in severity in the lower abdomen near the old scar. As soon as the pain became severe laparotomy was done and hysterectomy performed. The patient recovered and returned



Fig. 1. Case 6. Tear at site of old section scar. Note smooth edges.

home on the 12th day after operation. The infant was stillborn.

**CASE 9 (1949)** Colored quadripara, quintigravida, aged 22 years, at term, cephalic presentation. The patient was admitted in mild labor; bag of waters was intact; fetal heart tones were present. There were no symptoms of rupture. During repeat cesarean section a 2½ centimeter tear in the lower uterine segment was found with the bag of waters bulging through. The section was completed, the uterus resutured, and the patient sterilized. The patient recovered. The infant lived.

Of these patients who had undergone previous cesarean section 6 were in labor and 3 were not upon admission. Two of the patients had such mild symptoms that the rupture of the old scar was not suspected (Cases 5 and 9) but was discovered at the operating table at the time of repeat section.

Six uteri ruptured with transverse presentation.

**CASE 10 (1930)** White quadripara, quintigravida, aged 38 years. The patient was admitted with the bag of waters ruptured and hand and cord prolapsed. The duration of labor was unknown; fetal heart tones were absent. Delivery was accomplished by decapitation; the fetal trunk was removed and the head

# RUPTURED UTERUS

## A Report of 42 Cases

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J. E. FIELDS, M.D. Joliet, Illinois

**D**URING the 20 years from 1928 to 1947 inclusive there were 42 instances of ruptured uteri at the Cook County Hospital. In this same period 92,226 women were delivered of viable infants. Although rupture of the uterus is rare it carries an exceedingly high mortality for both mother and baby and therefore the subject seems worthy of review.

In the present series there were 23 maternal deaths or a maternal mortality of 54.76 per cent. The fetal mortality was 79.07 per cent—28 stillborn infants, 1 neonatal death and 5 infants who died in utero undelivered. Nine infants lived, a fetal saving of only 20.93 per cent.

In 16 cases the uterus ruptured before the women were brought to the hospital and in 26 instances the rupture occurred in the Cook County Hospital. Twenty-two of the mothers were white and 20 were negro.

Table I shows the distribution as to ages. It will be noted that the largest number of cases was in the age group of 36 to 40 years, inclusive and the next largest in the 21 to 25 year age group.

Thirty-eight ruptures were in multiparous and 4 ruptures were in nulliparous women (Table II).

The individual circumstances vary so much as to etiology, symptoms, degree of shock, diagnosis and treatment that it is almost impossible to make graphs of any value. We are therefore, stating briefly the salient facts in each case. An effort has been made to group the abstracts as to etiology.

In 9 cases rupture occurred following previous cesarean section. In the first 7 reported rupture occurred after previous classical sec-

tions and in Cases 8 and 9 after low cervical sections. (In patients 6 and 8 the original sections were performed at the Cook County Hospital).

**CASE 1 (1933)** White secundipara tertigravida, aged 27 years at term, cephalic presentation. Bag of waters was intact. The patient had been in labor for 12 hours, progressing normally to 7 centimeters and station plus 2 when she suddenly grabbed her abdomen and cried out. In 15 minutes profound shock ensued. Supravaginal hysterectomy was immediately performed and a transfusion of 1,000 cubic centimeters of blood given. She died of peritonitis on the 12th day after operation. The infant was stillborn.

**CASE 2 (1933)** White secundipara tertigravida, aged 31 years, 38 weeks gestation, cephalic presentation. The patient was admitted in mild shock, not in labor. Bag of waters was intact. She had sudden severe constant abdominal pain with marked tenderness over scar and easily palpable fetal parts. Blood transfusion was followed by prompt hysterectomy. Recovery was uneventful. She returned home on the 16th day after operation. The infant was stillborn.

**CASE 3 (1940)** White primipara secundigravida, aged 19 years, 38 weeks gestation, cephalic presen-

TABLE I—AGE

No. cases	Years
3	Under 20
	5
5	20-30
7	31-35
0	36-40
	Over 40

TABLE II

No. of cases	Para
4	
6	
3	
8	3
4	4
6	5
4	6
	7
	8
3	9

From the Department of Obstetrics, Cook County Hospital, and the Department of Obstetrics and Gynecology, Northwestern University Medical School.

CASE 17 (1933) White decipara duodecigravida, aged 33 years cephalic presentation. The patient was admitted with the cord prolapsed and having been in labor for 7 hours. Fetal heart tones were absent. Delivery was accomplished 8 hours later by version and extraction when dilatation was complete. Rupture of the lower uterine segment was found. Immediate hysterectomy was performed followed by blood transfusion. The patient died of peritonitis on the 10th day after operation. The infant was still born.

CASE 18 (1928) White septipara octigravida, aged 38 years. The patient was admitted in hard labor pains 2 to 3 minutes apart. Fetal heart tones were present but disappeared during labor. Twelve hours later the cervix was completely dilated station minus 1. Attempted delivery with Kielland forceps failed. Version and extraction followed. Exploration revealed a tear in the right lower uterine segment. Immediate hysterectomy was performed. The mother died of bronchopneumonia 3½ days after operation. The infant was stillborn.

Ironically Case 16 was mishandled according to good obstetric practice but the mother survived. In the presence of bleeding from what was thought to be a placenta previa, the cervix was *manually dilated* and version and extraction were performed. This procedure is to be condemned. In Case 17 the cervix was completely dilated when the version was performed but the patient died of peritonitis on the tenth postoperative day. Craniotomy was the procedure of choice in this latter instance since the baby was known to be dead with the cord prolapsed for 8 hours. In Case 18 a craniotomy was also preferable to version since the baby was known to be dead and for ceps delivery had failed. There is no excuse for jeopardizing the life of the mother when it is known that the baby is dead.

There were 4 cases in which oxytocics seem to have been the cause of rupture. 1 patient was given ergot and 3 patients were given pituitrin all before admission to the Cook County Hospital.

CASE 19 (1929) White nonipara decigravida aged 38 years cephalic presentation, floating. The patient was admitted after having been in labor at home for 4 days. She had been attended by a midwife who gave her "black medicine." On admission the patient had no pains, fetal heart tones were absent. Sterile vaginal examination revealed a cervical tear extending beyond the reach of the examining hand. Immediate hysterectomy was performed. The patient died of hemorrhagic purulent peritonitis on the 5th day after operation. The infant was stillborn.

CASE 20 (1938) White sextipara nonigravida aged 36 years face presentation. The patient was admitted in shock after having been in labor at home for 36 hours. Fetal heart tones were absent. On the afternoon of admission her physician had called and given her ¼ cubic centimeter of pituitrin following which she had had violent pains which stopped suddenly. Delivery was effected by version and extraction followed by blood transfusion. The patient died 2 hours and 50 minutes after admission before surgery could be performed. The infant weighing 11 pounds 7 ounces was stillborn.

CASE 21 (1939) Colored tertipara (one set of twins) tertigravida aged 34 years. The patient was admitted with head and shoulders delivered after labor of 3½ hours at home. Her physician had administered 1 ampul of pituitrin and was unable to deliver the other shoulder. En route to the hospital the other shoulder delivered spontaneously. The patient went into shock 25 minutes after delivery was completed in the hospital. Two blood transfusions were given for shock but she did not respond. She died 2 hours and 15 minutes following rupture of lower uterine segment. The infant weighing 12 pounds 6½ ounces was stillborn.

CASE 22 (1940) White sextipara, septigravida, aged 38 years. The patient was admitted in severe shock after having been in labor at home for 27 hours. Her physician stated that dilatation had been complete for 8 hours; he had given her pituitrin 2 minims twice. Four hours after the second dose the patient had had sharp pain causing her to double up. Laparotomy was carried out immediately and blood transfusions were given for shock. She survived this surgery and on the 28th day after operation returned home with a vesicovaginal fistula. She died of ascending infection 6 months later following a genitourinary operation when ureteral transplants were made into the sigmoid. The infant was stillborn.

In the ruptures attributed to oxytocics all 4 mothers and 4 babies lost their lives. In Case 20 the management of the patient after she arrived in the hospital in shock is to be criticized. The history of violent pains following the administration of ¼ cubic centimeter of pituitrin and then of sudden cessation of the pains makes the diagnosis of ruptured uterus obvious. A version and extraction procedure was contraindicated. Treatment of the shock and immediate laparotomy was the procedure of choice. What small chance the woman had to survive was destroyed by the additional trauma of the version and the failure to operate upon her promptly.

There are 6 cases which can be classified as more or less prolonged labors and probably disproportions.



extracted with a tenaculum without difficulty. A vaginal examination revealed laceration of the right broad ligament. There was no bleeding and no packing was inserted. The patient was not operated upon. She died 3 days postpartum of serofibrinous peritonitis. The infant was stillborn.

**CASE 11 (1932)** White quintipara, sextigravida, aged 31 years. The patient was admitted with the bag of waters ruptured and hand prolapsed. The duration of labor was unknown but a private physician had attempted version and extraction in the home. The cervix was completely dilated on admission and fetal heart tones were absent. Decapitation was done, placenta was not expelled, and exploration revealed that it was not in the uterus. Immediate laparotomy was performed for complete laceration extending from the cervix to within 3 centimeters of the fundus. The patient died of peritonitis on the 7th day after operation. The infant was stillborn.

**CASE 12 (1933)** White quintipara, septigravida, aged 24 years. The patient was admitted with the bag of waters ruptured and hand prolapsed. Fetal heart tones were absent. She had been in labor for 7 hours. Delivery was effected by version and extraction following which she immediately went into shock. Immediate hysterectomy was carried out. She recovered and returned home on the 5th day after operation. The infant died.

**CASE 3 (1940)** White quintipara, sextigravida, aged 30 years. The patient was admitted after having been in labor for 10 hours 5 minutes. Fetal heart tones were absent, bag of waters was ruptured. There was slight vaginal bleeding, the head was high on the right, the detached placenta was felt on the left and a tear was felt in the uterine wall. The abdominal aorta was compressed by the examining hand until hysterectomy was performed. The patient made an uneventful recovery and returned home on the 13th day after operation. The infant was stillborn.

**CASE 14 (1943)** White secundipara, tertigravida, aged 33 years, transverse presentation. The patient was admitted after having been in labor for 3 hours. The bag of waters was intact. She had had a vaginal plastic and Sturmdorf operation 4 years before. The patient was in the operating room being anesthetized for cesarean section when the cord and arm prolapsed. Version and extraction were carried out through the completely dilated cervix. Immediate total hysterectomy was performed, the tear in the posterior vaginal wall was sutured, 1,500 cubic centimeters of blood and 500 cubic centimeters of plasma were administered. The patient died 30 hours after operation. The infant died.

**CASE 15 (1928)** White tertipara, quadrigravida, aged 36 years. The patient was admitted with a history of marked respiratory distress and of syncope for 2 days. The bag of waters was ruptured, fetal heart tones were questionable. She was in labor for 24 hours with severe pains. When the pains ceased sudden "cardiac decompensation" followed. Morphine sulfate, trophine and digitalis were ad-

ministered. Twelve hours after admission the patient was losing ground. The cervix was 8 centimeters dilated, the hand prolapsed, a version and extraction was done without difficulty. The patient died immediately following delivery, there was a tear in the right fundus. The stillborn infant weighed 10 pounds 3 ounces.

Two of the women with transverse presentations and known dead babies were delivered by decapitation, 1 was delivered by cesarean section and 3 by version and extraction. All were in labor when they arrived at the hospital. There were 4 stillbirths, 1 neonatal death and 4 mothers were lost. In Case 11 version had been attempted by a physician in the home, this patient died of peritonitis on the seventh postoperative day. In Case 14 a previous vaginal plastic operation had been performed and a cesarean section was planned. While the patient was being anesthetized for surgery a cord and arm prolapsed. A vaginal examination revealed complete dilatation and a version and extraction procedure was done, resulting in a tear in the lower uterine segment. In spite of immediate surgery and the administration of 1,500 cubic centimeters of blood and 500 cubic centimeters of plasma, the patient died of shock postoperatively. In Case 15 apparently rupture had occurred at home and the subsequent shock was erroneously interpreted as cardiac decompensation. Had her true condition been recognized on admission to the hospital she might have been saved with blood transfusions and prompt surgery.

There were 3 other cases of version and extraction, Cases 16, 17 and 18, which with Cases 12, 13 and 14, total 6 cases of ruptured uterus attributable to version and extraction.

**CASE 6 (1929)** White quintipara, sextigravida, aged 37 years, cephalic presentation, station minus 3. The patient was admitted after having been in labor at home for 20 hours and attended by a physician. The bag of waters had ruptured 16 hours previously. She had had 6 pains for 1 hour before admission. Fetal heart tones were absent, there was moderate bleeding from the placenta previa. The cervix was dilated manually. Version and extraction were carried out with forceps on the aftercoming head. The patient went into shock. Sterile vaginal examination revealed a tear. Surgery was not done. The patient recovered and returned home on the 16th postpartum day. The stillborn infant weighed 8 pounds 8 ounces.

CASE 17 (1933) White decipara duodecigravida, aged 33 years cephalic presentation. The patient was admitted with the cord prolapsed and having been in labor for 7 hours. Fetal heart tones were absent. Delivery was accomplished 8 hours later by version and extraction when dilatation was complete. Rupture of the lower uterine segment was found. Immediate hysterectomy was performed followed by blood transfusion. The patient died of peritonitis on the 10th day after operation. The infant was still born.

CASE 18 (1928) White septipara, octigravida, aged 38 years. The patient was admitted in hard labor pains 2 to 3 minutes apart. Fetal heart tones were present but disappeared during labor. Twelve hours later the cervix was completely dilated station minus 1. Attempted delivery with Kielland forceps failed; version and extraction followed. Exploration revealed a tear in the right lower uterine segment. Immediate hysterectomy was performed. The mother died of bronchopneumonia 3½ days after operation. The infant was stillborn.

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CASE 20 (1938) White sextipara, nonigravida, aged 36 years face presentation. The patient was admitted in shock after having been in labor at home for 36 hours. Fetal heart tones were absent. On the afternoon of admission her physician had called and given her 4 cubic centimeter of pituitrin following which she had had violent pains which stopped suddenly. Delivery was effected by version and extraction followed by blood transfusion. The patient died 2 hours and 50 minutes after admission before surgery could be performed. The infant weighing 11 pounds 7 ounces was stillborn.

CASE 21 (1939) Colored tertipara (one set of twins) tertigravida, aged 34 years. The patient was admitted with head and shoulders delivered after labor of 3½ hours at home. Her physician had administered 1 ampul of pituitrin and was unable to deliver the other shoulder. En route to the hospital the other shoulder delivered spontaneously. The patient went into shock 25 minutes after delivery was completed in the hospital. Two blood transfusions were given for shock but she did not respond. She died 2 hours and 15 minutes following rupture of lower uterine segment. The infant weighing 12 pounds 6¼ ounces was stillborn.

CASE 22 (1940) White sextipara septigravida, aged 38 years. The patient was admitted in severe shock after having been in labor at home for 27 hours. Her physician stated that dilatation had been complete for 8 hours; he had given her pituitrin 2 minims twice. Four hours after the second dose the patient had had sharp pain causing her to double up. Laparotomy was carried out immediately and blood transfusions were given for shock. She survived this surgery and on the 28th day after operation returned home with a vesicovaginal fistula. She died of ascending infection 6 months later following a genitourinary operation when ureteral transplants were made into the sigmoid. The infant was stillborn.

In the ruptures attributed to oxytocics all 4 mothers and 4 babies lost their lives. In Case 20 the management of the patient after she arrived in the hospital in shock is to be criticized. The history of violent pains following the administration of ¼ cubic centimeter of pituitrin and then of sudden cessation of the pains makes the diagnosis of ruptured uterus obvious. A version and extraction procedure was contraindicated. Treatment of the shock and immediate laparotomy was the procedure of choice. What small chance the woman had to survive was destroyed by the additional trauma of the version and the failure to operate upon her promptly.

There are 6 cases which can be classified as more or less prolonged labors and probably disproportions.



There were 2 disproportions due to hydrocephalus in multiparous patients one a secundipara and one a sextipara, resulting in the deaths of both mothers and both babies.

CASE 29 (1930) Colored sextipara, septigravida, aged 35 years. This patient was admitted in mild labor with pains 10 minutes apart. Twelve hours later the uterus became tetanic and the classical signs of threatened rupture were present. A craniotomy was performed for the hydrocephalus 14 yards of gauze packing was used for the postpartum hemorrhage. The patient died on the delivery table of hemorrhage from a cervical tear extending into the broad ligament. The infant was stillborn.

CASE 30 (1944) White secundipara, tertigravida, aged 34 years cephalic presentation floating. The patient was admitted with severe pains after 40 hours of labor at home. The fetal head was perforated through the 4 centimeter cervix with a Smellie perforator 500 cubic centimeters of serous fluid escaped and the head collapsed. Shock ensued 30 minutes after the head was perforated. The patient was given oxygen, plasma, aminophylline. She did not respond to shock treatment and died undelivered 1 hour 25 minutes after admission. The tear in the lower uterine segment was discovered at postmortem examination.

In 2 cases there appeared to be a defect in the fundus of the uterus

CASE 31 (1934) Colored nullipara, primigravida, aged 38 years. The patient was admitted not in labor, with bag of waters intact, fetal heart tones not heard. The patient had had 1 day periods for 5 months followed by amenorrhea for 3 months progressive abdominal enlargement and persistent abdominal cramps. Her condition had been diagnosed as fibroids or ovarian cyst. At laparotomy the fetus was protruding through the fundus with the top of the fundus gone. Recovery was uneventful and she returned home on the 10th day after operation. The infant lived.

CASE 32 (1932) Colored tertipara, quadrigra, aged 27 years. The patient was admitted in shock not in labor at 5 months gestation. Her pregnancy had been normal except for occasional pain until 1 hour before admission when she had had intense abdominal pain vomited, and fainted. Her abdomen was tympanitic, distended and there was no mass up to the umbilicus. Immediate supracervical hysterectomy was performed for perforation of the uterine wall by the placenta. The uterine wall was paper thin. Recovery was uneventful and the patient returned home on the 11th day after operation. The infant was stillborn.

In the 38 year old nullipara, the symptoms and findings were misleading and the patient was operated upon by the gynecologic service

with a diagnosis of pelvic tumor. The infant was premature and half of its body was protruding through a defect in the fundus of the uterus. The placenta was normally attached. Both mother and baby survived.

In Case 32 the patient was a tertipara, who came to the hospital in shock. At abdominal section the placenta was found to have perforated or eroded the uterine fundus and was lying in the abdominal cavity. The 5 month fetus was dead of course but the mother made an uneventful recovery.

In 4 cases the ruptured uterus seems to have been associated with unusually severe uterine contractions and/or rapid labor the so-called precipitant type of labor.

CASE 33 (1936) Colored secundipara, tertigravida, aged 24 years. The patient had a normal spontaneous delivery after a labor of 13 hours 50 minutes during which time she had severe pains postpartum bleeding was present. The cervical tear was repaired. Three transfusions were given hysterectomy for tear in the lower uterine segment was performed 19 hours postpartum. She had a stormy postoperative course and returned home on the 16th day after operation. The infant lived.

CASE 34 (1937) Colored quintipara, septigravida, aged 28 years. The patient was admitted in moderate labor the cervix dilated to 3 centimeters station minus 1. In 1 hour the cervix was dilated to 5 centimeters in the presence of severe pains. Shock ensued 1 hour later the abdomen was distended and very tender, uterus was palpated below the umbilicus. Immediate laparotomy was performed stimulants and a transfusion of 1000 cubic centimeters of blood were given in the operating room. The patient died 1 hour after surgery in spite of more blood and stimulants. Two infants were stillborn.

CASE 35 (1947) Colored sextipara, septigravida, aged 32 years. The patient had been in labor for 3 hours 50 minutes during which time the fetal heart tones disappeared. Breech delivery was attempted to bleed and the uterus became doughy. For 12 hours conservative treatment was followed, then sterile vaginal examination revealed a tear in the left side of the cervix and lower uterine segment. Laparotomy was performed and 3 transfusions and penicillin were administered. The patient recovered and returned home on the 12th day after operation. The infant was stillborn.

CASE 36 (1933) White octipara, duodecigravida, aged 38 years. The patient had severe pains for 2 hours 40 minutes before spontaneous delivery. Two hours postpartum she went into profound shock from vaginal bleeding. Vaginal examination revealed a deep tear into the lower uterine segment.

The patient died before the anticipated surgery could be performed. The infant lived.

All of the women who had a precipitant labor were multiparous (para 2 5 6 and 8). In 3 instances, the labor was less than 4 hours long and there are constant references in the nurses' notes to severe pains. Two of these mothers died (Cases 34 and 36). The cause of death apparently was shock and hemorrhage. One death occurred before transfusion could be administered or surgery could be done.

Five ruptures were due to trauma of various sorts.

CASE 37 (1932) White nullipara, primigravida, aged 31 years. The patient was admitted with a 7 months gestation, positive Horner's sign, fetal heart tones were absent. She had a mild hypertension and pus in the urine. A 7 centimeter bag which was inserted came out spontaneously but the patient had no pains. The bag of waters ruptured and she went into shock. Supportive treatment was given but she died of peritonitis following lower uterine segment perforation 52 hours after bag induction. Fetus and placenta were in the peritoneal cavity.

CASE 38 (1936) White nonipara, decedgravida, aged 45 years. While scrubbing the floor 10½ hours before admission the patient developed severe sharp pain in the lower abdomen, vaginal bleeding and weakness followed, and she was brought to the hospital in shock. Immediate laparotomy was performed, blood was not available. She died 3 hours after admission and 1 hour after surgery. The infant was stillborn.

In Case 37 with a dead fetus of 7 months gestation a 7 centimeter bag was inserted. The patient died undelivered of peritonitis apparently due to a perforation of the uterine wall by the bag.

waters intact. Spontaneous delivery of the 6 month fetus occurred. Morphine sulfate and external heat (for acute alcoholic stupor with "cardiac decompensation") were administered. She died 8 hours after delivery. Postmortem examination revealed a traumatic fundal rupture. The infant was stillborn.

CASE 40 (1940) Colored tertipara, tertigravida, aged 32 years. Breech delivery occurred at home while she was unattended. Placenta was retained for 2 hours. Relatives pulled on the cord then a physician attempted to express the placenta by Credé's method but failed, finally manual removal was carried out at home. Upon admission the patient was bleeding and had cramping pain. Three transfusions were administered for shock but the rupture was not diagnosed and no operation was attempted. She died of purulent peritonitis and endometritis 66 hours after admission with perforation of the fundus and some placental tissue in the peritoneal cavity. The infant lived.

CASE 41 (1940) White primipara, secundigravida, aged 28 years. The patient was admitted because of toxemia with a blood pressure of 170/115. Medical induction failed four times and labor was induced by stripping membranes. Bag of waters ruptured spontaneously and fetal heart tones disappeared. An attempt to convert brow failed and delivery was effected by craniotomy and cleidotomy. Total labor lasted 14 hours 30 minutes. Supportive treatment with blood transfusions, sulfanilamide intravenous fluids, and Levine suction was carried out. The rupture was not diagnosed and not operated upon. The patient died of rupture of the uterus with infection, hemorrhage, and generalized anemia, 5 days postpartum. The infant was stillborn.

One patient, Case 39, fell down the stairs while intoxicated. Her serious condition was masked by her alcoholic stupor and she expired unoperated upon 8 hours after entrance.

In Case 40 the manual removal of the retained placenta at home resulted in death.

Four days after admission medical induction with castor oil and quinine resulted in mild labor at 10:00 p.m. on November 18 1947 pains were at 10 minute intervals. An hour later the patient became restless, at 1:00 a.m. the blood pressure rose to 200/124 and the fetal heart tones disappeared. The cervix was effaced, dilatation 3 centimeters and station minus 2 the uterus relaxed normally between pains. At 1:50 a.m. her blood pressure was 165/105 she was co-operative at 4:30 a.m. with a pulse of 88. At 5:30 a.m. she was extremely restless and died at 5:40 a.m. undelivered. Though labor was apparently progressing normally and she was treated for hypertension she died during labor.

This patient's clinical course suggested a nonconvulsive eclampsia and at postmortem examination it was discovered that there was also a ruptured uterus. After studying the microscopic sections, the pathology department was of the opinion that the toxemia was a large contributing factor to the cause of death.

#### SUMMARY

In a critical analysis of the material we find that there were 25 instances of ruptured uterus in the first 10 years (1928-1937) during which period 40 327 viable infants were delivered an incidence of 1 in 1 613. In 11 of these patients rupture had already occurred on entrance to the hospital—2 from defective uterus, 2 from external trauma, 5 from prolonged labor (1 after receiving black medicine\*) 1 rupture after a previous classical section and 1 after an attempted version and extraction in the home. During this decade 11 of these patients lived and 14 died. The cause of death was peritonitis in 7 cases, shock and hemorrhage in 5, bronchopneumonia in 1, and undiagnosed in 1 (masked by alcoholic stupor).

In the second 10 years (1938-1947) there were 17 cases of ruptured uterus during which time 51 899 patients were delivered of viable infants making an incidence of 1 in 3 054. In 8 of this group rupture had already occurred upon admission. Three patients had received pituitrin on the outside, 2 had had previous classical sections and 1 a previous low cervical section. 1 had had a manual removal of the placenta, 1 was a neglected transverse. In this decade 9 women survived and 8 died. Four deaths were attributed to shock and hemorrhage and in 4 others no diagnosis was made and no operation performed.

TABLE III.—MORTALITY

	No. cases	Per cent
Mothers		
Lived	19	45.24
Died	23	54.76
Infants		
Lived	9	20.93
Died undelivered	5	11.63
Stillborn	28	65.12
Neonatal death.	1	2.32

\*One set of twins.

The fact that the incidence was reduced by half in the latter 10 years would seem to indicate that better obstetrics is being done throughout the Chicago area. However, the infrequency of the incidence in the second period reduced the diagnostic acuity resulting in 4 undiagnosed cases with death in each. The 7 fatalities due to peritonitis in the first decade might have been reduced in number had antibiotics and chemotherapy been available. There were 5 deaths due to shock and hemorrhage in the first decade and 4 in the second indicating that even when adequate blood is available ruptured uterus is an exceedingly dangerous condition and frequently fatal.

There were 13 ruptures in the upper uterine segment, 22 in the lower uterine segment and 7 instances in which the location of the rupture was not described.

Twenty-eight women were operated upon, 18 of whom survived and 10 died. In the 6 instances in which the rupture was diagnosed, surgery was not accomplished because the course of the patients was so rapidly downhill. None of these survived. Two patients, whose condition was diagnosed, were electively not operated upon. One of these died and 1 recovered. In 6 cases in which the condition was not diagnosed and operation not performed, all patients died. The only appreciable salvage was in the group in which diagnosis was made and operation performed—64.28 per cent of these patients survived. In the group not operated upon only 1 patient (7.18 per cent) was saved. From these figures it is evident that there is no advantage in surgical delay and very little possibility of improving the patient's condition until the cause of the hemorrhage is eliminated.

## CONCLUSIONS

1. Forty two cases of ruptured uteri (an incidence of 1:3196) observed at the Cook County Hospital during a 20 year period, 1928-1948 inclusive are reported and analyzed.

2. The maternal mortality was 54.76 per cent and the infant mortality was 79.07 per cent.

3. Careful observation of the intranatal patient and good obstetric practice would prevent most ruptures.

4. Diagnostic acuity prompt surgery plus the administration of adequate blood and judicious use of the available chemotherapeutics and antibiotics would decrease the mortality from this condition.

# DEXTRAN

## An Experimental Plasma Substitute

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**P**ARTIALLY hydrolyzed dextran administered intravenously as a 6 per cent solution in normal saline has recently been proposed as a plasma substitute in the treatment of shock and hemorrhage. Following chemical and physiological studies at the University of Upsala under the direction of Tiselius (11) its clinical trial was first reported by Grönwall and Ingelman in 1945 (12)

*Physical chemistry of dextran* Dextran is a water soluble high molecular natural polysaccharide first described in the nineteenth century and later found to be a common contaminant of beet sugar. It is prepared commercially by dialysis from solutions of saccharose infected by *Leuconostoc mesenteroides* and purified by repeated precipitation with alcohol. The dextran molecule corresponds to the formula  $(C_6H_{10}O_5)_n$  with the glucose units connected by a gentiobiose (1-6 glucosidic) linkage (33). Its suggested structure consists of a long main chain of glucopyranose units with shorter side chains each composed of about 5 such units giving a postulated thickness of about 10 glucopyranose molecules (23), or about 50 angstroms. Study with the electron microscope reveals a 'thread like structure' which is usually branched and even when quite diluted seems to have no appreciable tendency to divide into smaller parts. The rough estimate of the molecular thickness of 30 to 100 angstrom units was however at the limit of the resolving power of the electron microscope used (17, 18). The raw material is only partially soluble in water and the resulting solutions are very viscous. It has a slow electrophoretic migration toward the positive electrode, a specific rotation of 195 degrees

and a molecular weight of many millions. By carefully controlled partial hydrolysis a modified dextran is obtained which has a nonuniform molecular weight of between 100,000 and 200,000 and passes through capillary walls slowly. This modified dextran in a 6 per cent solution has been proposed as a 'plasma substitute' by Grönwall and coworkers. The following data describe the physical chemical properties of the dextran modified for intravenous therapy. The colloidal osmotic pressure (300 to 400 mm H<sub>2</sub>O) is equivalent to that of normal blood plasma. Isoelectric point, pH 5.9 to 6.1; nitrogen content, 0.003 to 0.01 milligram per cubic centimeter; viscosity, 3 to 4 with an Oswald viscometer at 37 degrees Centigrade and the buffer capacity 6 to 7 cubic centimeters of tenth molar sodium hydroxide. The dextran sedimentation constant (determined in the ultra centrifuge) at a concentration of 0.7 per cent varies between  $1.5 \times 10^{-12}$  to  $20 \times 10^{-12}$ , and the diffusion constant varies between  $0.2 \times 10^{-7}$  to  $8 \times 10^{-7}$ .

*Immunology of dextran* Grönwall and Ingelman (11) carried out a brief immunological study on dextran. Rabbits were injected with 2 cubic centimeters of 0.5 per cent dextran solution every fifth day for a period of 2 months. The sera were then tested for precipitin formation by addition of dextran solution of varying concentration. None occurred. No mention was made as to whether pure dextran or the hydrolyzed product was used in these studies. Neill and Hehre, however, had previously found that pure dextran is a serologically active polysaccharide (14, 30). They reported the formation of serologically active dextran from sucrose solution by various strains of nonhemolytic streptococci isolated from the blood of patients with subacute bacterial endocarditis from several strains of group 'H' throat streptococci, and from

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strains of *Streptococcus salivarius* isolated from the throat and feces. Cross-immunological relationships of the dextran so formed occurred with several strains of *Leuconostoc mesenteroides* and with type 2 type 12 and type 20 pneumococci. Consequently in view of the frequent contamination of commercial sugars with leuconostoc bacteria and also with dextran itself and because of the frequency with which pneumococcal and streptococcal infections occur it would not be surprising if a great many people were found who would harbor antibodies capable of reacting with unhydrolyzed dextran. In support of this theory a majority of people, skin tested by Neill and Hehre<sup>1</sup> with unhydrolyzed dextran gave positive reactions in high dilution. Complete hydrolysis of the dextran molecules prevented this reaction. Whether dextran itself is capable of stimulating the formation of specific antibodies was not stated.

**Physiological studies.** Extensive studies on dextran and its behavior after parenteral administration have been carried out by Grönwall and Ingelman (12). Unhydrolyzed dextran in solutions of 1 to 3 per cent were injected into rabbits with resultant albuminuria. Repeated injections caused anuria and death in an unstated number of dogs. Microscopic studies revealed thrombosis of capillaries in the liver and kidneys with surrounding areas of anemic necrosis. Later on testing solutions of partially hydrolyzed dextran it was discovered that a dextran of medium molecular weight, in the range of 100,000 to 200,000 still retained its beneficial hemodynamic effects and could be given with safety to experimental animals. Because of the asymmetry of the dextran molecule such molecular size was necessary in order to prevent rapid passage through the glomerular membranes.<sup>2</sup> This modified dextran solution was then given to rabbits and dogs as replacement therapy after experimental hemorrhage. No deleterious reactions were noticed nor was there any gross or microscopic evidence of storage in the tissues. The concentration of dextran in both

the blood and urine was investigated. After administration the plasma dextran level decreased rapidly for a few hours then the rate of excretion became a relatively straight line curve reaching zero within 4 days. This early fall in the plasma dextran concentration is due to the rapid excretion through the glomeruli of the smaller dextran molecules, the mean molecular weight of which was calculated to be from 50,000 to 60,000.

One undesirable consequence observed following dextran was the greater tendency toward pseudoagglutination of the red blood cells and the associated increase in sedimentation velocity. Such changes bore a direct relationship to both the concentration of the dextran solution used and the size of its molecules. In vivo experiments, however, revealed that the relationships between the dextran level in the plasma and the sedimentation rate varied in different individuals. Grönwall and Ingelman concluded that although an increased sedimentation rate is, in itself not harmful the occurrence of injurious reactions secondary to this agglutination tendency is yet a possibility and that a decision could naturally not be expected before the dextran solutions have been injected in great amounts into humans and the sedimentation reaction studied with respect to the dextran content of the blood. This same effect, of course had been usually observed following the infusion of many other plasma substitutes such as gum arabic, pectin and gelatin.

**Clinical testing of dextran.** Initial clinical testing was carried out by Grönwall and Ingelman in 1943 at the University of Uppsala, and later at the Central Hospital in Örebro under the direction of G. Bohmanson and O. Wilander. Finally large scale clinical trials were conducted at Örebro at Stigberget's Hospital and the Serafimer Hospital in Stockholm under Grönwall and Thorsén, and also at St. Göran's Hospital in Stockholm by Rosenkvist. Throughout this period 22 different preparations and about 1,000 bottles were used (3). Each preparation before being released had been tested on terminal cancer cases in Stigberget's Hospital.

Prior to March, 1945 many batches were discarded because of allergic and pyrogenic

<sup>1</sup>Personal communication.

<sup>2</sup>When measurement of the relative viscosity of dextran solutions was found to be a reliable test for the degree of hydrolysis, this method was employed to determine the suitability of the different preparations.

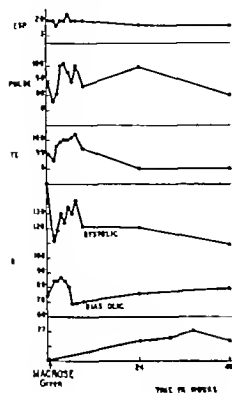


Fig. 1. Clinical response to macrose.

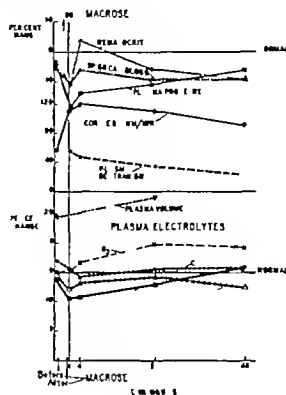


Fig. 2. Blood changes after macrose infusion.

reactions. Since then only occasional preparations have been deleted for this reason. As a result of the studies at Örebro in 1943 the composition of the dextran preparation was gradually modified the molecular size was reduced the viscosity was decreased from 4.5 to 5.2 to between 3 and 4 and the saline content lowered from 3 to 0.9 per cent. This new solution was introduced in 1944 and it is the preparation now employed in Sweden.

#### THE CLINICAL STUDIES CARRIED OUT AT THE PRESBYTERIAN HOSPITAL

Thirty chosen volunteer patients received macrose solution intravenously. One patient, a terminal cancer case received 1000 cubic centimeters of the solution a few days prior to death. The autopsy findings in this case have not been presented in this paper because of the presence of advanced bilateral hydronephrosis consequent to the spread of the carcinomatous process from the cervix to the adnexa and the neighboring tissues and lymph nodes. This condition unfortunately, served to obscure any renal changes which might have been found as a result of the infusion of macrose. Twenty five patients received as

much as 500 cubic centimeters each the infusions being given by the drip method in not less than 30 minutes. No seriously ill patient was chosen. Careful clinical observations were made both during the infusion and for several days thereafter. Temperature, pulse, respiration and blood pressure were recorded at frequent intervals. Urinalyses (routine) hematocrit, capillary specific gravity, erythrocyte sedimentation rate, blood grouping, plasma and urine dextran level, blood volume study, plasma protein level and electrolyte studies were carried out in selected patients.

A résumé of a typical case is presented.

**CASE 6.** W.R. aged 16 years, male, white. Unit No 837242. Diagnosis ankylosis of jaw following infection of both temporomandibular joints at the age of 3. Patient was admitted to the hospital July 16, 1946.

On July 17 a cartilage graft taken from a rib was transferred to the mandible. The postoperative course was not complicated.

On July 23 the patient was given an intravenous infusion of 500 cubic centimeters of 6.0 per cent macrose over a period of 30 minutes. There was no immediate clinical reaction to the infusion. Two hours after termination there was a slight rise in both pulse and temperature with the latter returning to normal at the end of 24 hours (Fig. 1). The blood

TABLE I.—REACTIONS TO MACROSE SOLUTION IN CASE 6

	Pre-macro		Post-macro			
	Pre-macro			4	43	7
Plasma derived (grams %)		25	5		16	(1)
Correct sedimentation rate (mm in 1)	5		10		90	
Hematocrit—%	5		5.5	5	5	43.5
capillary blood specific gravity	1	0.995	0.9	1	0.93	
Plasma proteins (grams %)	6.2	5	6	6	6.2	6.6
Plasma sodium mEq/l	42			22.5	3.8	25.1
Plasma potassium mEq/l	30		0.4	20	22	65
Plasma chloride ml/l	107	0.5		62.5	75	106.6
Plasma U <sub>2</sub> ml/l	27		5	20.5	30	
Plasma volume ml	72			2900		
Red R volume ml	30			1720		
Body weight gms				70	75.4	75.5

pressure did not change significantly. At the end of 4 hours a gain of 5.4 kilogram of body weight occurred whereas the plasma volume increased only 2.3 cubic centimeters.

There was an immediate drop and secondary rise in hematocrit, peripheral blood specific gravity and plasma proteins (Fig. 2 and Table I) indicating a transient hemodilution. In the 24 and 43 hour specimens hemodilution was again present. The sedimentation rate doubled its initial value and remained elevated. The dextran level fell rapidly at uniform rate. There was no significant change in the electrolytes studied.

The patient was discharged from the hospital on July 26.

This case is presented to illustrate the various changes which took place in the blood chemistry. An interesting feature is the temporary hemoconcentration noticed at the 4 hour sample. This is what was found in those patients who reacted to the macrose solution. Those who had no reaction as a general rule showed hemodilution. Another feature is the gain in weight exhibited over a period of several days a phenomenon noted in several patients.

#### SUMMARY OF CLINICAL STUDIES

1 *Clinical observations* In several instances the blood pressure declined somewhat following the infusion in others it was accompanied by a slight increase together with a greater rise in pulse pressure. Correspond-

ingly small increases in temperature pulse and respiration were noted. In only 3 cases was the fall in blood pressure sufficiently alarming to require therapy. There were no shaking chills or spikes in fever. Flushing of the face and neck, urticaria, and a few other symptoms were experienced in several of the patients.

2 *The hematocrit* The hematocrit determinations in 19 cases are incorporated in a scattergraph (Fig. 3). Seven of these had reactions following the administration of macrose and separate graphs were made of these 7 patients. Hemoconcentration was observed in these reactors with definite hemodilution occurring later. Twelve nonreactors, on the other hand showed immediate hemodilution which was maintained from 24 to 43 hours.

3 *The specific gravity of capillary blood* Capillary blood specific gravity was measured at the bedside in 19 patients. A similar hemodilution of peripheral blood occurred in the nonreactors as was noticed in the venous blood hematocrit determinations. Similarly those patients who had reactions showed capillary hemoconcentration which persisted for at least 4 hours. These changes are recorded by means of a scattergraph in Figure 3.

4 *Erythrocyte sedimentation rate* The corrected erythrocyte sedimentation rate was investigated in 14 cases. These findings are de-

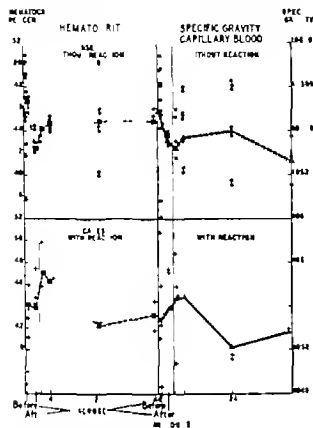


Fig 3 Effect of macrose upon the hematocrit and specific gravity of capillary blood

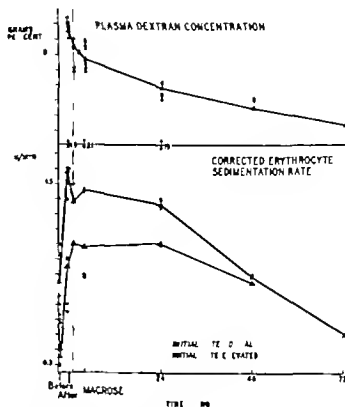


Fig 4 Effect of macrose upon erythrocyte sedimentation rates.

predicted by means of a scattergraph in Figure 4. In all there was an immediate rise in the sedimentation velocity. The subsequent decline in the erythrocyte sedimentation rate to the original values could not be definitely correlated with the decrease in the plasma dextran level. An *in vitro* experiment demonstrated however that with any given blood sample a rough correlation between the erythrocyte sedimentation velocity and the concentration of dextran did exist (Fig 5).

**5 Plasma dextran levels.** Plasma dextran determinations were carried out in 12 cases. The highest levels were found in the 15 minute specimens and in 1 case it was 0.84 gram per cent. The concentrations fell rapidly for the first few hours and then assumed a more gradual but uniform rate of fall. At 24 hours the plasma dextran was approximately one half of the postinfusion level (Fig 4). By the third day a very low concentration of dextran remained in the plasma.

**6 Blood grouping.** The blood groups were typed before and immediately after the macrose infusion in 3 cases: whole blood on slides

and cell suspensions in saline being used. No difficulty was encountered in obtaining the correct blood group.

**7 Urinalyses.** Urinary dextran determinations although not reliable quantitatively indicated qualitatively that dextran passed into the urine during the first 24 hours but very little was excreted during the second 24 hour period in 3 of the intensively studied cases. Routine urinalyses before and for sev-



Fig 5. Effect of varying concentration of dextran on sedimentation rate *in vitro*.

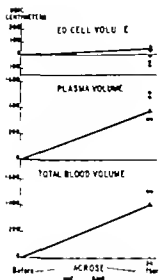


Fig. 6. Blood volume after macrose.

eral days after the infusion revealed no important changes.

8 *Plasma volume* Plasma volume was measured in 7 cases. These values are recorded in graph form in Figure 6. At the end of 24 hours the plasma volume of these 7 cases was an average of 370 cubic centimeters greater than it had been prior to the infusions. None of these patients had had reactions.

9 *Plasma proteins* Plasma proteins were analyzed in 6 patients. These are shown in Figure 7. The drop in plasma proteins roughly parallels the hemodilution as observed by means of the hematocrit and capillary blood specific gravity.

10 *Electrolytes* In 7 cases the concentration of sodium potassium chlorides, and his carbonate ions were determined before and at intervals after the infusion of macrose. Both the sodium and potassium ions decreased the latter more than the former due to the sodium contained in the infusion. After the first hour the sodium concentration continued to fall and that of the potassium ion to rise. At the 48 hour postinfusion sample the values had returned to normal.

The chlorides were little affected. Immediately after the macrose there was a small rise due no doubt to the chloride ion in the infusion. A slight acidosis existed in the cases studied. Following macrose this condition

was improved by the end of the 4 hour period. On the whole the variations in the electrolytes in these 7 patients was not significant (Fig. 8). More such studies are needed.

11 *Reactions to macrose* Of the 30 patients given infusions of macrose there were 10 who had definite reactions. Four were females and 6 males. Six received the full 500 cubic centimeters of the 6 per cent macrose solution. In 4 cases the infusion was stopped after 400 cubic centimeters, 20 cubic centimeters, 400 cubic centimeters, and 75 cubic centimeters respectively because of the advent of reactions. These reactions have been divided roughly into 3 different groups: (1) skin reaction (flushing, pruritus and urticaria) 6 cases; (2) circulatory reaction (cyanosis and fall in blood pressure) 3 cases; (3) asthmatic reactions, 1 case. Nineteen of the 20 remaining cases received the full 500 cubic centimeters of macrose solution intravenously without symptoms. The twentieth case received 1000 cubic centimeters (500 c.c. on 2 successive days). Those patients who had reactions of one kind or another also had significant changes in the temperature, pulse, respiration or blood pressure. Other symptoms which may or may not be significant are headache, 3 cases; drowsiness, 3 cases; and restlessness, 2 cases. In 7 of the 10 who had reactions and in whom hematocrits and peripheral whole blood specific gravity tests were carried out, hemoconcentration was observed. Hemodilution on the other hand was the rule for all those who did not have reactions. In the non-reactors blood studies were carried out in 12 of the 20 and hemodilution in some degree was noted in each. The changes in the hematocrit and in the specific gravity of capillary blood of both those with reactions and those without reactions are presented in Figure 3. Average values are recorded for both those patients who had reactions and those who did not. As the groups presented are statistically small and as the preinfusion values of the hematocrits and specific gravity determinations varied widely from patient to patient, this graph is open to criticism. On the other hand the general trend observed is what is found on individual analysis of any of the different cases. As allergic manifestations character

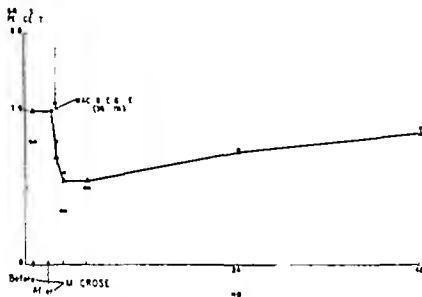


Fig. 7 Changes in plasma proteins (biuret) after macrose.

istically show hemoconcentration it is likely that the reactions observed are related and are either of anaphylactic or anaphylactoid nature.<sup>1</sup>

A résumé of Case 30 is presented. This patient experienced a severe asthmatic reaction.

J. M. aged 21 years male white Unit No 669788. Diagnosis recurrent osteomyelitis. Patient was admitted to the hospital July 22 1946. Discharged August 18 1946.

This patient had developed an osteomyelitis of the right femur and left radius in March 1942 and had subsequently been admitted to the hospital on four separate occasions for treatment. A fifth admission in January 1944 was because of bronchial asthma influenza and bronchopneumonia. Sputum cultures at this time were positive for *Pneumococcus* type 20. His past history was irrelevant except for hives as an infant and an unsubstantiated history of hay fever for two summers. Physical examination showed a healthy young male with positive findings limited to the right hip and the left wrist. Culture of pus from sinus of right hip was positive for *Staphylococcus aureus*.

On July 22 incision and drainage of an abscess of the right hip was carried out. His postoperative condition was good. On July 24 upon completion of the routine preliminary control tests an infusion of 6 per cent macrose was started at 9205 a.m. The rate of the infusion was approximately 60 drops per minute. Within a very few minutes the patient's face and neck became flushed and he began to cough repeatedly. Auscultation of the chest revealed a few

expiratory wheezes. The macrose infusion was stopped immediately (not more than 20 c.c. had been given) and the patient was given 3 minims of 1:1000 adrenalin by hypodermic. When it was seen that the patient was becoming increasingly dyspneic and cyanotic, oxygen by mask was instituted and a second 3 minims of adrenalin was given. Following this therapy there was a gradual lessening of the dyspnea so that one hour later all symptoms had disappeared.

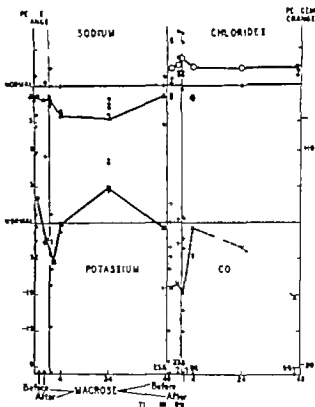


Fig. 8. Effect of macrose upon the plasma electrolytes.

<sup>1</sup>Sterile infusion sets were used throughout. Baxter Number 18-R, Number 11-R, and Number 8 sterile 1 lb. and needle sets were used. Reactions were obtained with each of the three different recipient sets.

<sup>2</sup>Bottle No. 33, lot No. 55 control no. B2 2, infusion set Baxter No. 8-R.

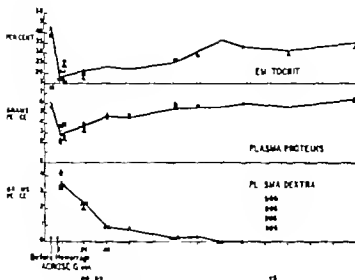


Fig. 9. Macrosc infusion following exsanguination.

Since he received only 30 cubic centimeters of macrose, no significant concentration of dextran in the plasma was detected. The sedimentation rate did not change until 24 hours later when a significant rise occurred. There was an immediate rise in the hematocrit followed by a fall back to normal in the 4-hour specimen. There occurred no appreciable change in the specific gravity of peripheral blood or the plasma protein concentration. Blood volume before and 24 hours after macrose was little altered. The variations in electrolytes were only minor. Plasma sodium fell during the first 4 hours and returned to normal at the end of 24 hours. There was a slight increase in the plasma potassium between the sample taken at the 4 and 24-hour periods. There was no alteration of body weight during the first day. The patient was discharged from the hospital on the 15th day after operation. No late sequelae were noted either in the hospital or in the out-patient department.

#### **PATHOLOGICAL STUDIES AT THE PRESBYTERIAN HOSPITAL**

Resuscitation of dogs with macrose and subsequent autopsy findings.

Six dogs were bled an estimated 50 per cent of their blood volume and were immediately given an equal volume of 6 per cent macrose. The experimental procedure was similar both to that used by Ivy and his coworkers in 1943 and to the method adopted by Buttle, Kelwick, and Schwentzer in cats, 1940.

Under procaine local anesthesia, the jugular (internal) vein and common carotid artery on one side

were exposed. The carotid artery was then cannulated and the blood allowed to flow into a graduated cylinder until the animal stopped breathing or until the arterial bleeding was reduced to a slow drip. When this state was reached, the animals were given a rapid infusion into the internal jugular vein of a volume of macrose equal to that of the blood lost.

At 1, 4, and 24 hours following the infusion and then every other day up to the 15th day jugular vein blood was secured for hematocrit, plasma dextran protein and specific gravity.

**Results.** These 6 dogs lost on the average as a result of their bleeding 42 per cent of their total blood volume.<sup>1</sup> After receiving 400 to 500 cubic centimeters of macrose they were all able to walk unaided. In fact the clinical response of the dogs to the infusion was quite dramatic. Of the 6 dogs, only 1 died. This animal had pneumonia, responded well to the infusion but then gradually weakened and after exhibiting increasing drowsiness, was found dead in his cage 3 hours after the infusion.

The blood studies on 4 of these dogs are present in Figure 9. The hematocrit dropped to a low of 15.8 per cent and rose very slowly to near the initial level at the end of 2 weeks. The plasma proteins had an equally sharp fall but recovered more quickly with some

<sup>1</sup>The calculated blood volumes are determined by the Stewart method used by Ivy et al. (2). 9.5 per cent of body weight.

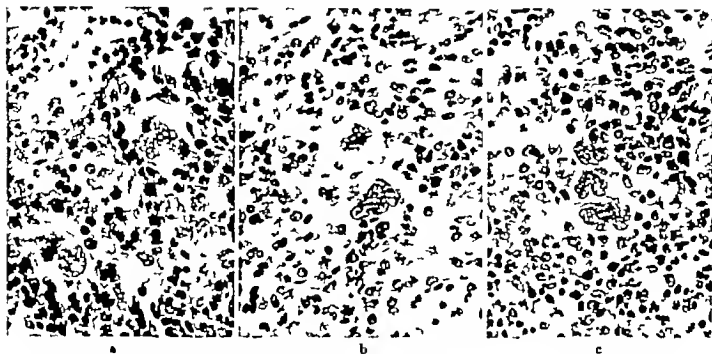


Fig. 10. a, b, c (dogs 2, 4, 5) 14 days, 11 days, and 5 days after infusions. Spleens. There is moderate reticulo-

endothelial hyperplasia with the formation of multinucleated giant cells.  $\times 335$

figures near the preliminary level at the end of 1 week. The plasma dextran levels decreased from levels as high as 4.1 grams per cent immediately after the infusion to a very low level by the fifth and sixth days. No marked change was found in plasma specific gravity determinations carried out before and for several days after the infusion.

**Autopsy studies.** Each of the 6 dogs was subjected to autopsy and microscopic sections were prepared. Dog 5 with pneumonia died 3 hours after the infusion. Dogs 1, 2, 3, 4, and 6 appeared strong and in general good health and were sacrificed on the 19th, 14th, 13th, 11th, and 5th days respectively after the infusions.

Autopsy studies on dog 5 revealed no gross changes of interest other than a general anemia and pallor of all the tissues and a nodular consolidation of the right middle and right lower lobes and of the left lower lobe. Histological studies confirmed the diagnosis of a diffuse lobular pneumonia of severe degree.

Autopsies on the other 5 dogs were carried out at the same time. The tissues were grossly normal in appearance and the organs were of normal size and weight. There was no evidence of edema and no increases in peritoneal, pericardial, or pleural fluids. General pallor

of the tissues was evident. Specimens for histological study were taken from the livers, spleens, kidneys, and lungs.

**Microscopic examination.** Sections of lungs revealed no change. The spleens of all 5 dogs (Fig. 10) showed evidence of moderate reticuloendothelial hyperplasia together with the formation of multinucleated giant cells of epithelioid type. These cells resembled megakaryocytes. The livers of dogs 3 and 4 presented multiple small areas of midzonal focal necrosis (Fig. 11). The liver of dog 1 exhibited several small focal collections of mononuclear cells without evidence of necrosis. The kidneys of dog 3 appeared normal with exception of slight dilatation of some of the tubules and some of Bowman's capsules. The kidneys of the other 4 dogs (Figs. 12, 13) exhibited varying degrees of focal glomerular and tubular damage with atrophy, necrosis, and some epithelial proliferation of the glomerular tufts, minimal hyalinization of the loops of edema, vacuolization, fatty and colloidal degeneration of tubular cells, and dilatation of the tubules and of the Bowman's capsules. Less than 10 per cent of the total glomeruli and tubules were involved by this process. Eosinophilic hyaline debris and clumps of pinkish-purple amorphous material arranged sometimes in concentric rings were found within a number of glomeruli. Similar debris and clumps of epithelial cells in various stages of necrosis and calcification were present in some of the collecting tubules. Special stains for iron and calcium were employed and they

<sup>1</sup>The microscopic sections are from the Department of Surgical Pathology under the direction of Dr. Arthur P. Stout, Professor of Surgery.





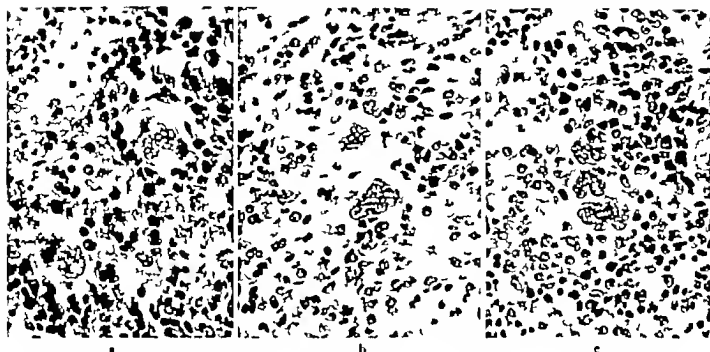


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of the tissues was evident. Specimens for histological study were taken from the livers, spleens, kidneys and lungs.

**Microscopic examination**<sup>1</sup> Sections of lungs revealed no change. The spleens of all 5 dogs (Fig 10) showed evidence of moderate reticuloendothelial hyperplasia together with the formation of multinucleated giant cells of epithelioid type. These cells resembled megakaryocytes. The livers of dogs 3 and 4 presented multiple small areas of midzonal focal necrosis (Fig 11). The liver of dog 1 exhibited several small focal collections of mononuclear cells without evidence of necrosis. The kidneys of dog 3 appeared normal with exception of slight dilatation of some of the tubules and some of Bowman's capsules. The kidneys of the other 4 dogs (Figs 12, 13) exhibited varying degrees of focal glomerular and tubular damage with atrophy, necrosis and some epithelial proliferation of the glomerular tufts, minimal hyalinization of the loops of edema, vacuolization, fatty and colloidal degeneration of tubular cells and dilatation of the tubules and of the Bowman's capsules. Less than 10 per cent of the total glomeruli and tubules were involved by this process. Eosinophilic hyaline debris and clumps of pinkish purple amorphous material arranged sometimes in concentric rings were found within a number of glomeruli. Similar debris and clumps of epithelial cells in various stages of necrosis and calcification were present in some of the collecting tubules. Special stains for iron and calcium were employed and they

<sup>1</sup>The microscopic sections are from the Department of Surgical Pathology under the direction of Dr. Arthur P. Stout, Professor of Surgery.



Fig. Dog 3. a, Nineteen days after infusion. In the center of the field there is a collection of mononuclear cells together with a few polymorphonuclear leucocytes. The hepatic cells show extensive glycogen storage.  $\times 35$ .

b, Dog 3. Thirteen days after infusion. Liver. Focal midzonal necrosis. The hepatic cells show extensive glycogen storage.  $\times 35$ . c, Dog 4. Eleven days after infusion. Liver. Focal midzonal necrosis.  $\times 35$ .

c affirmed the presence of these substances in this amorphous debris. Both the lower and upper portions of the nephron were involved in this degenerative process. The fatty degeneration however involved only the proximal convoluted tubule. That the glomerular damage was of recent date was evidenced by the lack of organization or scar formation.

#### DISCUSSION

The attributes of an ideal plasma substitute have been summarized by Amberson, Moon, Cohn, Scudder (38) and others. Briefly such an agent should have: A colloidal osmotic pressure of plasma proteins (300 to 400 mm. of water); large molecular size with molecules of symmetrical shape; low viscosity; chemical stability in the wet and dried states; an ionic strength of physiological proportions; a high buffer capacity; and a pH near that of blood. It should be nontoxic, nonantigenic, easily metabolized, not retained as a foreign body and possess the power of restoring protoplasmic irritability. Finally it should withstand sterilization, transportation, and storage without deterioration. A 6 per cent solution of partially hydrolyzed dextran fulfills many of these strict prerequisites but not all. One striking deficiency is the long and highly asymmetrical molecular structure.

One harmful effect of this asymmetry is the greatly increased erythrocyte sedimentation velocity observed in all the patients given macrose. This effect is a characteristic of many macromolecular substances. In 1918 Fåhræus demonstrated that the sedimentation rate was correlated with changes in certain plasma constituents especially fibrinogen and globulin and in 1921 Fåhræus published an exhaustive historical review and experimental study on the suspension stability of the blood and reported that gum arabic and other macromolecular substances produced pseudoagglutination and consequently increased the sedimentation velocity. This work, together with that of Karsner and Hanalik and of others, has been augmented in recent years so that now Meyer and associates in 1945 believe that probably all highly asymmetrical molecules of large size will cause an increase in the sedimentation rate when added to normal blood. The reasons for this phenomenon are not definitely known. However it has been observed in many instances to be reversible and it also has been observed that chemical and enzymatic breakdown and depolymerization of these high molecular weight substances will prevent any such increase in the agglutinability.

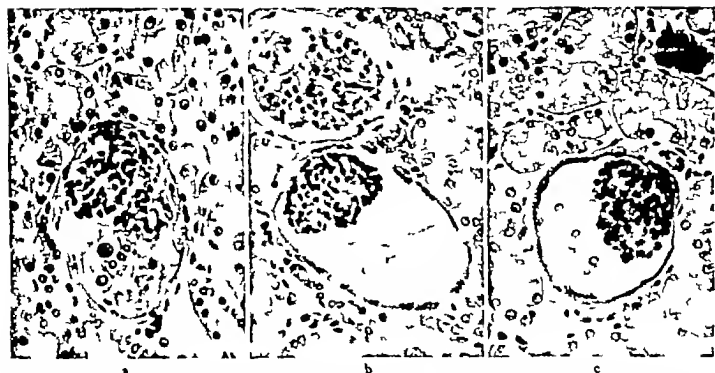


Fig 12. a, Dog 1 Nineteen days after the infusion. Cortex of kidney showing shrunken glomerular tuft and dilated Bowman's capsule. The lumen of the glomerulus contains calcified masses of foreign material and eosinophilic debris.  $\times 335$ . b, Dog 2 Fourteen days after infusion. Cortex of kidney showing shrunken glomerular tuft with pyknotic nuclei. The glomerular space contains eosinophilic

debris and Bowman's capsule is dilated.  $\times 335$ . c, Dog 4. Eleven days after infusion. Cortex of kidney showing shrunken necrotic glomerular tuft, dilatation of the capsule, and calcium containing debris within the lumen. Note the ringed appearance of the foreign bodies in the glomerular space. The tubules show fatty degeneration.  $\times 335$ .

ity of red blood cells (28) Nungester and Klein reported that the addition of type 3 Pneumococcus polysaccharide to normal blood would also increase the sedimentation rate and that type specific antiserum would abolish this effect. As dextrans are serologically active bacterial products (14) we now have a second known bacterial product which will increase the erythrocyte sedimentation rate. It is likely that many such substances will be found in the future.

The extent to which this macromolecular substance of asymmetrical shape is stored in the body and its catabolism are not yet known. In vitro experiments have thus far revealed only a slow reduction with starch splitting enzymes (12) and as no evidences of accumulation have heretofore been detected in experimental animals it is believed that a gradual enzymatic destruction of the molecule does take place. Slow excretion or breakdown of the dextran molecules is, of course desirable. In the treatment of the shock state one is primarily interested in restoring the circulat-

ing blood volume to normal and in maintaining it at that level until the body is able to compensate for the loss of fluid volume through its own compensatory mechanisms. It is only when there is severe reduction in blood volume, tissue anoxia, and capillary damage that prompt therapy is mandatory employing plasma or a plasma substitute until blood is available. Such aid is needed for only a short time and as a rule for not more than 12 hours. It is known that regeneration or restoration of plasma proteins after blood loss takes place rapidly if shock is not present (25). As much as 10 to 29 per cent of the normal plasma proteins enters the circulation in the first 12 hours and a similar amount during the second 12 hours (8). Our own experiments with dogs discussed in this paper tend to confirm these observations.

*Is partially hydrolyzed dextran toxic?* The histological findings observed in a series of 6 dogs who received macrose solution intravenously have been described. Some of these changes are not reversible but were minimal

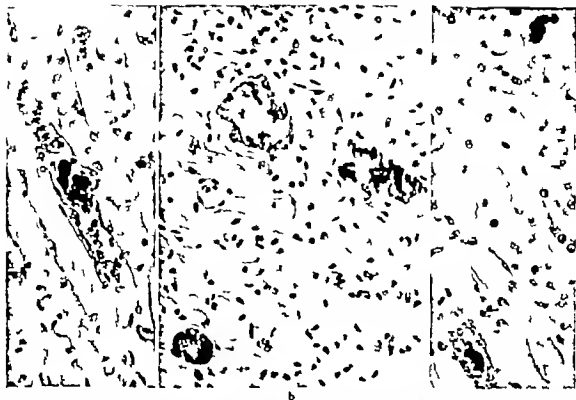


Fig. 3. a, Dog. Nineteen days after the infusion. Medulla of kidney showing cellular casts within the lumen of tubule. Calcified debris is present within the tubule in the center of the photograph.  $\times 325$ . b, Dog 4. Eleven days after infusion. Medulla of kidney. There is calcified debris within the lumens of three collecting tubules. The tubular epithelium is necrotic. On the right, cellular out-

lines can be distinguished within the partially calcified mass.  $\times 325$ . c, Dog 6. Five days after infusion. This photomicrograph of the medulla of the kidney shows tubular degeneration with calcified debris in the lumen. At the top of the photomicrograph, tubule is seen which contains numerous erythrocytes as well as calcified debris.  $\times 325$ .

and only focal in nature. In comparison with the Swedish group who observed no pathologic alterations in the tissues, the amount of macrose solution used in our animals was relatively high. These changes are somewhat similar to those found by others investigating several colloidal plasma substitutes.

Hueper contends that certain macromolecular substances employed as plasma substitutes (acacia, polyvinyl alcohol pectin) are pathogenic when administered intravenously. He has presented evidence revealing organic changes to be frequently found and characterized by storage in the reticuloendothelial system; degenerative vascular changes often identical with atheromatous or arteriosclerotic lesions, and degenerative and proliferative changes in the glomeruli. Popper associates have also observed pathol-

changes following the administration of macromolecular substances.

*Is partially hydrolyzed dextran antigenic?* This question cannot be answered at this time; the reader however is referred to the experimental work of Neill and Hehre. Our own experience which includes 10 reactions in a series of 30 cases, leads us to believe that these reactions were of allergic nature. Whether chemical modification of the dextran so-

serological activity (3) The reactions were not anaphylactic but anaphylactoid in nature, and consequent to the cellular damage produced by the action of this macromolecular substance. It is not believed that the presence of protein impurities was likely because the nitrogen content of the bottle of macrose used in Case 30 was determined in duplicate and assayed to be only 0.0051 and 0.0050 milligram per cubic centimeter. Aerobic and anaerobic cultures were also carried out on bottles of macrose 2 of which caused allergic manifestations. These were negative for leucocytosis and other bacteria. By way of further analysis blood sera from 4 patients who had received dextran were then sent to Neill and Hehre for study. These sera were taken 7, 11, 24, and 27 days after the macrose infusions. Precipitin reactions were carried out with negative results.<sup>1</sup> A culture of *Staphylococcus aureus* from patient 30 with osteomyelitis was also submitted to Neill and Hehre. It was found not to produce dextran diate asthmatic reaction to the dextran infusion had been admitted to the hospital in January 1944 with a diagnosis of bronchial asthma and bronchopneumonia. His sputum cultures at that time revealed large numbers of *Pneumococcus* type 20. This is of interest as Neill and Hehre had shown immunological relationships between *Pneumococcus* type 20 and dextran. No similar relationship was traced in any of the other reactors.

In 3 of these cases the more common symptoms and manifestations of allergy (such as asthma, urticaria) were absent. Instead they presented signs of cardiovascular collapse with a drop in blood pressure, cyanosis, and in 1 patient definite lowering of temperature of the extremities. All required supportive therapy oxygen by mask and 5 per cent glucose and saline. Hemocoagulation was present in each. Plasma sodium, potassium, chlorides and carbon dioxide determinations were carried out in Case 19 but no significant changes were found.

It is likely that here again we have an anaphylactoid or anaphylactoid reaction but without clinical involvement of a different tissue. It is

<sup>1</sup>Personal communication.

of interest to recall at this point the work of Hanzlik and Karsner who in 1920 had shown that many colloidal substances on intravenous administration will give rise to anaphylactoid phenomena of circulatory and respiratory nature.

Cyanosis was an interesting phenomenon noticed in several of these cases. This discoloration was at first discounted because blue dye technique were being carried out. However in other patients who did not have these blood volume measurements cyanosis of mild degree was also observed. In all cases blood samples drawn after the macrose infusion appeared darker than did the preliminary blood specimen. Shaking this blood would lighten the color but later after settling had taken place the blood would again become darker than its control. In patient 19 where cyanosis was an important feature together with vascular collapse an analysis of the oxygen carrying capacity revealed a normal value of 18.9 volumes per cent. In carrying out this analysis however the chemist remarked that it took abnormally long for the blood to become completely saturated. Such reduction in the speed of oxygenation of the erythrocytes has been observed both in the human and in the experimental animal after polyvinyl alcohol methyl cellulose, acacia, and gelatin (6, 19, 26). A similar discoloration of blood was noticed when Nungester added *Pneumococcus* and Olney reported in 1935 that although the carbon dioxide content of the blood after administration of acacia decreased proportionately with the hemodilution as observed by Hanzlik the oxygen content fell at the end of 1 hour to a more marked degree than would be expected and that this effect persisted for more than 24 hours. This effect has been attributed by Hucper to the formation of surface films of the macromolecular matter on the erythrocytes with resulting impairment of the gaseous interchange across the interface.

Two other possible reasons for the cyanosis in these cases are related to the well known effect of macromolecular substances in increasing the coagulation of erythrocytes as first noted by Hanzlik and Karsner in 1920 and

Fåhræus in 1921 (1) Thus conglutination could result in a decreased functioning surface area for use in the interchange of gases. (2) It also might result in slowing and obstructing the flow of blood in the smaller capillaries. Fåhræus, Parkins, Hopps, and Youngner and Nungester all have reported the microscopic visualization of capillary blood flow following the administration of various colloidal solutions and plasma substitutes. Each of these authors noted that pseudoagglutination of red blood cells took place. Their observations, however, show no unanimity of opinion as to whether or not slowing of the blood flow actually did take place as a result of this agglutination.

### CONCLUSIONS

1. Thirty volunteer patients at the Presbyterian Hospital were given infusions of macrose—a 6 per cent solution of partially hydrolyzed dextran. The lot number of the solution used in each case was B2-2. Ten of these patients had reactions of either anaphylactic or anaphylactoid nature. A striking increase in sedimentation rate was noted in all. These reactions are believed to be specifically related to the molecular structure of the dextran molecule and its concentration in the plasma. A possibility exists that some undiscovered impurity was present in this solution but in view of the work of Neill and Hehre we feel that the weight of evidence incriminates the dextran molecule itself.

2. No great changes in the levels of the various blood electrolytes were found following the administration of dextran solution. Studies were carried out on the plasma sodium, potassium chlorides, and carbon dioxide.

3. Satisfactory hemodilution and increase in plasma volume was noted after macrose. This effect persisted for a period of at least 24 hours.

4. Plasma proteins regenerated rapidly following exsanguination and replacement of the blood loss with macrose solution.

5. Autopsy studies on 6 dogs who received macrose, Lot B2-2 in large quantities revealed focal degenerative lesions in the livers and kidneys and minimal reticuloendothelial hyperplasia in the spleen.

NOTE.—The clinical testing of macrose solution was carried out at The Presbyterian Hospital in the City of New York on the Second Surgical Division of the late Dr. Hugh Auchincloss, between June 5, 1945, and July 5, 1945. In all, 30 patients received macrose solution intravenously. Because of the severity of the reaction encountered in Case 30 with recurrent osteomyelitis, it was considered unwise to continue the clinical testing of this batch of solution beyond this date.

### Methods for determinations

The *hematocrits* were centrifuged in Sanford-Magath tubes for one hour at 3,000 r.p.m. using heparin as an anticoagulant (36).

The *sedimentation rates* were determined by the Rourke-Erasmus method (35).

The *concentration of macrose in plasma* was determined by the method of Harry Hint, Pharmacia, Ltd. (unpublished) as adapted by Margaret E. Smith for the Evelyn photoelectric colorimeter.

The *whole blood specific gravity determinations* were obtained by the method described by Barbour and Hamilton (3).

The *plasma volume determinations* were done by the dye (T 1824 or Evans blue) dilution method of Gregersen (37).

The *plasma proteins* were determined by the biuret method of Kingsley (38) as modified by Mehl (39) and adapted for use with the Evelyn photoelectric colorimeter.

The *carbon dioxide combining power* was determined by the method of Van Slyke and Neill (30).

The *plasma chlorides* were determined by the potentiometric titration method (34).

The *plasma sodium levels* were obtained by the gravimetric method of Butler and Tuftill (41).

The *potassium analyses* were done by modification of the argentocobaltinitrite method (37).

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## CYTOLOGIC EXAMINATION OF SPUTUM AND BRONCHIAL SE- CRETIONS IN DIAGNOSIS OF BRONCHOGENIC CARCINOMA

IT is becoming evident that primary carcinoma of the lung is a much commoner lesion than has been recognized in the past. In part this results from the inaccessibility of a good portion of the bronchial tree to ordinary bronchoscopic methods. It has been claimed that the cytologic examination of sputum and bronchial secretions results in many more definitive diagnoses of cancer of the lung.

The rationale for the examination of secretions throughout the body for carcinoma depends on the exfoliation of carcinoma cells from malignant tumors having a free surface. Cancer cells differ from normal cells by having large nuclei, in irregularity in size of cell and nucleus, altered nuclear cytoplasmic ratio, hyperchromatism and large nucleoli.

This principle was noted by Papanicolaou<sup>1</sup> in 1928 while working with vaginal secretions.

Up to 1935 only an occasional diagnosis of carcinoma of the lung had been made by the examination of the sputum and usually then when a fragment of tumor was identified in the sputum. In 1935 Dudgeon and Wrigley<sup>2</sup> devised a special technique for the cytologic examination of sputum. This method involved the fixation of wet films in Schaudin's solution and staining with hematoxylin and eosin. By this means they were able to demonstrate malignant cells in 68 per cent of 58 cases of proved bronchogenic carcinoma. Barrett<sup>3</sup> in 1938 and Gower<sup>4</sup> in 1943 reported positive results of examination of sputum in 68 and 64 per cent of cases, respectively. A monograph was written on the subject by Wandall<sup>5</sup> of Copenhagen in 1944. He found that the sputum contained cancer cells in 84 per cent of 100 cases of proved bronchogenic carcinoma. Results of bronchoscopic biopsy were positive in 55 per cent of patients who were studied in this manner. A study of secretions removed bronchoscopically from patients was carried out by Iferbut and Clerf<sup>6</sup> in 1946. They reported positive results in 82.4 per cent of 57 cases of proved bronchogenic carcinoma. It was felt by Iferbut and Clerf that sputum was an inaccurate and too time-consuming material for study. Papanicolaou<sup>7</sup> in 1946 reported positive results from the examination

<sup>1</sup>Papanicolaou, G. N. *New cancer diagnosis*. Proc. Third Race Betterment Conf., 9, 2, p. 5, 2.

<sup>2</sup>Dudgeon, L. E., and Wrigley, C. H. *J. Lar. Otol., Lond.*, 1935, 50: 751-76.

<sup>3</sup>Barrett, N. K. *J. Thorac. Surg.*, 1938, 8: 60-83.

<sup>4</sup>Gower, F. J. B. *Brit. J. Surg.*, 1943, 30: 91-100.

<sup>5</sup>Wandall, H. H. *Acta chir. scand.* (suppl. 83), 1944, 10: 1-14.

<sup>6</sup>Iferbut, P. A., and Clerf, L. H. *Med. Clin. N. America*, 1946, 30: 324-303.

<sup>7</sup>Papanicolaou, G. N. *J. Am. M. Ass.*, 1946, 13: 377-378.

of sputum in 88 per cent of 25 cases of proved bronchogenic carcinoma. Woolner and McDonald examined sputum, bronchial secretions and bronchial washings and have felt that all materials should be utilized. During this time they have made a positive diagnosis of cancer cells in approximately 325 cases.<sup>1-6</sup> The stain which they have employed has been hematoxylin and eosin.

Bronchial washings are obtained by instilling 5 cubic centimeters of saline solution into the affected bronchus and recovering the material. This can be centrifuged and the sediment stained after smearing. Bronchial secretions as obtained through the bronchoscope can be handled in comparable fashion to sputum. The advantages of bronchial secretions and bronchial washings are that material can be more or less selectively obtained from the affected bronchus. The specimen is undiluted with extraneous material such as one obtains from the mouth and other parts of the lung. It has the further advantage that it makes possible the examination of patients who cannot produce sputum and it takes less time to examine than does sputum. The most obvious advantage of sputum is its ease of collection and the facility with which one can obtain multiple specimens for examination. In cytologic work examination of multiple specimens is very important.

The authors have employed the smear technique rather than placing the material in a paraffin block and sectioning. Probably the

McDonald, J. R., and Woolner, L. B. Carcinoma cells in sputum and bronchial secretions: an analysis of 100 cases in which results were positive. Unpublished data.

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most important part of the technique is the inclusion of Papanicolaou's suggestion namely wet fixation of the smears in a fixative (50 per cent ether and 50 per cent of 95 per cent ethyl alcohol). It becomes very obvious that considerable experience is necessary to run a cytologic laboratory. The average time required for the examination of a single smear of sputum is ten minutes; five smears are examined from each sputum and in cases in which cancer cells cannot be found three specimens of sputum have been examined with a total average examination time of two and one half hours. If the patient is ambulatory he is given 30 cubic centimeters of 95 per cent ethyl alcohol in a bottle and the sputum is collected in this fixative. This obviates the necessity of obtaining fresh material which is very difficult particularly on an out-patient service.

In Woolner and McDonald's first 300 positive specimens of sputum and bronchial secretions they had 4 proved false positives 3 of which occurred in the first 150 cases. The vast majority of positive cases proved to be primary bronchogenic carcinoma. They demonstrated that cells were exfoliated in many cases of alveolar carcinoma, but only occasionally in metastatic carcinoma and never in adenoma of the bronchus. Occasionally positive cells could be recovered in cases of cancer of the larynx and of the esophagus.

Of those patients in this group who underwent bronchoscopy, positive tissue was obtained in 55 per cent of incidences. It would appear therefore, that the cytologic examination of sputum and bronchial secretions is of definite aid in the diagnosis of primary carcinoma of the lung.

In an endeavor to determine the false negative error, they investigated a group of 588 cases in which cytologic examination was carried out during the time 100 positive re-

sults were obtained. The final clinical diagnosis in this group of cases proved to be bronchogenic carcinoma 147 cases, indeterminate probably nonneoplastic, 39 cases, probably metastatic carcinoma, 30 cases, adenoma of the bronchus, 5 cases, nonneoplastic pulmonary disease, 367 cases. The smear technique thus resulted in 68 per cent positive results, a figure which would closely approximate that of the English workers. It would appear that the false positive error should be less than 2 per cent while the false negative error is about 30 per cent. Under such circumstances, the method will prove to be a valuable diagnostic aid in cases of cancer of the lung.

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LEWIS B. WOOLMER

## THE RISK OF SURGICAL OPERATION

AN inevitable question to be dealt with whenever surgical operation is being considered is its risk. The patient may ask directly how dangerous the operation is, the point may be covered implicitly in the discussion, or the patient may leave the question entirely to the surgeon's best judgment. The risk of operation is frequently difficult to weigh; the danger must be balanced against the probable benefit; an intensely personal relationship between surgeon and patient is involved, yet other members of the patient's family, other possible patients and other physicians may be concerned in the decision. All these points create an intellectual challenge of the first order for the surgeon, and the challenge is just as real in relation to the surgical treatment of advancing and otherwise incurable disease as in "elective" operations.

In the first place it is obvious that the patient consulting a particular surgeon is concerned with the risk of operation as performed

by that particular surgeon with his particular skill and facilities. Morbidity or mortality figures from other clinics may have little bearing on the case at hand. In this connection we should note a source of error prevalent in medical graduate teaching. The error might be called a confusion of identity. For example, an experienced gynecological surgeon may report from a large clinic that the mortality rate of total hysterectomy is only a fraction of 1 per cent higher than that of supravaginal hysterectomy, and further may show that the incidence of carcinoma in the remaining vaginal stump more than nullifies the slight additional risk of total hysterectomy. Or a surgeon with a mortality rate of one per cent for subtotal gastric resection for supposedly benign gastric ulcer may report an incidence of 10 per cent for carcinoma in the removed specimens and conclude that all chronic gastric ulcers should be treated by subtotal gastric resection. For the two surgeons the facts are present and the conclusions valid. However, when the conclusions are passed with the weight of authority to surgeons throughout the country, serious harm may be done. The point may be missed that sound practice for a specialist in a large teaching center may not be safe practice for the average surgeon.

In the next place the patient is concerned with the operative risk for him as an individual and although he may be interested in the results his surgeon achieved in the last one hundred cases the significant point is the personal factor. What is his physiological reserve and how do his age and associated diseases affect his chances? How does his obesity, hypertension, coronary sclerosis, or pulmonary emphysema influence the risk of operation? Statistical abstractions would have little place in helping the average patient make up his mind in favor of surgical operation. The experienced surgeon is well aware

of the importance of having his patient come to operation with mental composure, a factor which in itself may affect the outcome.

Assessment of the risk of operation is complicated by the continuous forward motion of surgery and what may have seemed a reasonable hazard ten years ago may no longer be defensible. In the space of a few years after the discovery of vitamin K the mortality rate for operations on the bile ducts of jaundiced patients fell to one half or less. Sulfonamides, penicillin and streptomycin have changed the picture overnight and broadened the scope of surgery. Improvements in anesthesia and the knowledge of how to treat depleted or shocked patients have lessened the risk of operation and require constant re-evaluation of the question of surgical risk. Development of the residency training system reduces operative hazards and postoperative morbidity. Thus the surgeon is called on to estimate not a fixed value but a factor which is changing with general improvements in surgery as well as with his own increasing skill and experience. It is the obligation of referring physicians to keep these matters in mind also. It would be inexcusable for gastroenterologists for example to weigh the indications for colectomy in chronic ulcerative colitis in terms of the operative risk of twenty years ago.

The problem has special applications in relation to the uncommon surgical lesion the new operation or the specially complicated procedure. There are those who urge that the operative repair of strictures of the common duct should be done in a few centers by surgeons with unusual experience in the field. The operations for correction of vascular or of cardiac anomalies or the shunt operations for portal hypertension or resection of duodenum and pancreas tend to be practiced in only a few clinics, and unquestionably the results are better in a few rather than many

hands. Should all patients who need such specialized surgery be referred to certain centers? The question is not easy for there are personal social and economic factors involved as well as problems of graduate education and medical research. Nevertheless for the surgeon with less experience who is called upon to perform such procedures the question has ethical and moral aspects for he may sincerely feel that the patient is asking to be subjected to a greater risk than might result in a center for such surgery.

Since the risk of any major surgical operation will depend among other things on the condition of the patient the surgeon can influence the results in a series of cases by the extent to which he screens his patients and rejects poor risk cases. A too cautious attitude and anxious regard for mortality statistics on the part of the surgeon are not wholly commendable for presumably he should be bent on doing the most good for the most patients. Nevertheless it is possible to discredit an operative procedure by applying it as a last resort measure in desperate cases. Referring physicians as well as the laity in the community may lose interest, with the result that entirely suitable cases are not given their chance. This point is of special importance in chronic disease notably in hospitals for tuberculosis. Furthermore, the surgeon himself may become disheartened and abandon the procedure. And yet if a patient has one chance in ten of surviving an operation which promises cure and no chance of surviving without it, should he not be operated on? In bald form the question may seem easy but the problem in practice is never so clear-cut.

Here is but one illustration of the intellectual challenge of surgery and of the comprehensive demands on the surgeon's personal qualifications

JOHN D. STEWART



Samuel Johnson

1709-1784

From painting by Sir Joshua Reynolds

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## THE BOOK SHELF

### THE CASE OF THE ECCENTRIC LEXICOGRAPHER

ESTHER H VINCENT Evanston Illinois

SAMUEL JOHNSON so famous for his intellectual abilities, is almost equally famous for his physical disabilities. Indeed it was something of a shock to look upon him for the first time. Huge and grotesque, his tall, stooped figure was topped by a massive head with heavy scarred features, the thick-lipped mouth keeping up a continuous business of opening and shutting. His great body was never quiet—the fingers twirling, the hands twisting, the feet shuffling, the trunk rolling about. His clothes, thrown on anyhow, presented a shabby medley of ill-fitting wig, wrinkled coat, soiled shirt, falling stockings and scuffed shoes. And yet, except for Shakespeare, no writer of English has a larger or more eager assembly of scholarly fans.

When Sam was born in Lichfield in 1709, his father Michael was already past fifty-two and his mother Sarah was past forty. They had been married for some three years, and Samuel was the first of their two children. Besides keeping a bookshop at Lichfield, industrious Michael sometimes sold books in a stall at Birmingham, sometimes at other nearby towns. Michael wasn't much of a business-man and, although he achieved a few local honors, he and Sarah were almost always bearing the wolf at the door. Sarah was inclined to be a bit arrogant about her family being better than Michael's, but the only member known to us is her nephew, the notorious 'Parson Ford', said to be the clergyman sitting next to the punch bowl in Hogarth's *Modern Midnight Conversation*.

Michael had a large, robust body and a strong active mind, both of which he handed down to Samuel. But along with this goodly heritage went a 'vile melancholy' that plagued the both of them all their days. Sarah seems to have been a woman of unique understanding and of deep religious feeling. Both Michael and Sarah lived to a good old age, Sarah reaching the age of ninety.

From the Archbishop Church Library, Northwestern University Medical School.

The infant Samuel was far from promising. Born almost dead, he was unable so much as to cry out for a considerable time. But the man midwife declared, 'Here is a brave boy!' Dr Samuel Swinfen, the Johnson's young lodger and one of Sam's godfathers, said that he never knew of any child so difficult to rear. The baby stayed for some ten weeks at the house of a wet nurse who was blamed for his sore eyes. The eye trouble was probably tuberculous keratitis, but of course Michael and Sarah couldn't have been expected to realize it. A few weeks after birth, Sam developed some sort of lesion on his body also, and while he was still nursing, an 'issue' was cut in his left arm and left open until he was six. Some time in his second year, he was taken to a neighboring town to be examined by an oculist, and the next year to London. There, on the advice of Sir John Floyer, the distinguished physician, young Sam was touched for scrofula by Queen Anne, whom the child ever after remembered fearfully as 'a lady in diamonds and a long black hood.'

The little fellow was sent to a dame school and then to grammar schools at Lichfield and Stourbridge. Foolishly proud of him, Michael continually tried to make him 'show off', thus causing the intelligent lad no end of humiliation. His phenomenal memory was considered a fair field for exploitation by his teachers also. Even his school fellows recognized the clumsy, diseased boy's intellectual superiority, and three of them used to mount him on their shoulders and carry him to school.

Two years were spent in 'lounging' in binding, selling and reading books, and in making friends with Gilbert Walmesley and David Garrick. In 1728, young Johnson went up to Oxford, probably as result of a legacy left to his mother at that time. He stayed at the University for little more than a year, leaving for two reasons—too little money and too much melancholy. Hitherto he had compensated for poverty, disfigurement, and inability at sports by means of his intellect and a



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certain gay wit that he was accustomed to use with much gusto. But now there came a sudden change. While on a short visit home Johnson evidently suffered some mental crisis or accumulation of crises, and thereafter suffered eternal sadness. Oddly enough his gaiety kept company with his melancholy making him a paradox, a pessimist with an enormous zest for life.

His mental depression drove him to seek relief from Dr. Swinfen then of Birmingham, who so admired Johnson's self-written "case-report" that, forgetful of professional ethics, he showed it to several friends. According to Boswell, Johnson "felt himself overwhelmed with a horrible hypochondria, with perpetual irritation, fretfulness, and impatience and with a dejection, gloom, and despair which made existence a misery. He attributed to paternal inheritance the melancholy which made him mad all his life at least not sober." It was the indiscreet Dr. Swinfen who suggested to the poor youth that his melancholy might some day lead to madness. But in spite of his fear of insanity and death, the courageous Sam yet maintained his gorgeous appetite for learning, literature, good food and good company.

On leaving Oxford, Johnson got a series of teaching jobs, none of them very satisfactory, and made his start in the literary field by writing essays, prefaces, and the like. In 1731 his father died, leaving his ailing business to Sarah and their younger son Nathaniel. About this time too, Samuel met his future wife, Tetty Porter, a widow twenty years his senior and the mother of three children. Their mutual attraction is still a mystery but marry they did, in 1735, and lived happily together until Tetty's death in 1757 just as Johnson was beginning to be famous.

Meanwhile, Johnson, handicapped by an unprepossessing appearance, an indolent melancholy, poor eyesight and poor hearing, tried to set up a school of his own near Lichfield. This school lasted less than two years, but one of the few pupils was the dramatic David Garrick. Soon after brother Nathaniel died, possibly by his own hand, and Tetty's daughter eventually went to live with the old mother.

Samuel was drawn inevitably to the big city where he rambled along on his literary way writing, grubbing, planning, talking and living hugely amid the elegant squalor of Hanoverian London. At first sight strangers sometimes mistook him for an idiot, as did Hogarth, who first saw him at the house of novelist Samuel Richardson, "standing at a window in the room, shaking his head and rolling himself about in a ridiculous manner. Hogarth was struck with amaze-

ment when Johnson began to talk. Talking was necessary to Johnson, and in order to assure himself of a permanent audience, he founded a social club which later became the famous Ivy Lane Club. His list of friends grew long and interestingly varied—Garrick, Reynolds, Goldsmith, Edmund Burke and the gay Topham Beauclerk. Among the ten charter members of the Club were three physicians, William McGhie, almost the only Scotsman that Johnson ever could endure, young Edmund Barker and "Dear Bathurst, the 'good hater' whom Johnson loved.

In that day medicine existed for the benefit of its practitioners. In ordinary cases the physician did not bother to make a personal call. He used an intermediary an apothecary who reported the symptoms and received the Latin-written "bill" which specified the treatment. The apothecary then administered to the patient the clysters, purges, or emetics, and only called a barber-surgeon or a cupper when bleeding or cupping were necessary. The physician himself came only in serious cases and then charged a guinea or two-thirds of a guinea per mile. Consequently the poor had to depend on unlicensed practitioners and quacks. Many people dosed themselves according to their own ideas. Johnson was not alone in his faith in Dr. James's Powder for Fevers and Other Inflammatory Distempers, "a dangerous mixture of antimony and phosphate of lime, concocted by an old home-town friend.

Johnson loved the company of medical men and often said that they did more good to mankind without a prospect of reward than any profession of men whatever. He knew William Heberden, whom he regarded as "ultimus Romanorum, the last of the learned physicians. Then there was Dr. Nugent, Burke's father-in-law and Dr. Fordyce, a St. Thomas's staff member, a great gourmand, and the author of a popular textbook of medicine. When Johnson thought himself seriously ill, he sometimes consulted his old friend, Dr. Thomas Lawrence, a past-president of the Royal College of Physicians. Lawrence and Johnson had a fellow-feeling for one another as both were the victims of strange tics and convulsions, and both were hard of hearing. Usually however Johnson sought the advice of a member of his own household, Robert Levett.

Levett was one of those queer dependents whom Johnson gathered around him partly to serve as an outlet for his natural compassion, partly to keep him company after the death of Tetty. Levett and poor blind Anna Williams, together with the negro servant Francis Barber were the permanent occupants of that nest of odd birds

that kindly Samuel kept in his house. Levett was an uncouth fellow, a forlorn, middle-aged hanger on who had been apprenticed to a Hull draper had gleaned some medical lore from a neighbor had drugged in London to make money enough to take him to Paris, where he worked as a waiter in cafés frequented by surgeons. For five years he got free tickets to the best French lectures on the medical sciences. Then he returned to London where he healed the poor for a crust of bread a glass of gin, a few coins, or whatever they had to give him. He continued to attend such lectures as were free, and may be said to have gained his medical education by ear.

Johnson had very definite ideas on the subject of medicine and his views were considerably ahead of most of the physicians of his time. He disapproved of periodical bleeding and also of the current eighteenth century practice of poly-pharmacy. He fancied himself as a writer of prescriptions, not only for his own ills, but for those of his friends. To rheumatic Bennett Langton he sent a formula for sulphur mustard seed, sugar and infusion of the root of lovage. To Dr Lawrence, who suffered hemiplegia and aphasia, he suggested electrical treatments, and to Miss Boothby he prescribed powdered dry orange peel for dyspepsia.

He seems never to have paid fees, once remarking: 'Illness is of little expense to me, thanks to the generosity of my physicians. He may have given them books in exchange for treatment, for when Dr Warren attended him in his last illness, he said: 'Sir you come at the eleventh hour but you shall be paid the same as your fellow labourers. Francis, put into Dr Warren's coach a copy of the *Lives*. As a patient he was most trying, constantly interfering with his treatment. Long suffering Dr Lawrence once cried: 'If he would come and beat me once a week, I could bear it. But to bear his complaints is more than I can support.' Johnson kept a Latin diary of the state of his health and of the effect upon it of the remedies used.

Never a worshipper of Bacchus, Johnson eventually gave up alcoholic drinks altogether and substituted tea-drinking to the extent of fifteen or sixteen cups a day. During his later years, tea, talk and lemonade were his only solace. Smoking he never cared for.

The world has reason to be grateful to George III, whose well-intentioned stupidity finally blundered into giving the Great Moralist a pension. Within five years of gaining economic security, Samuel had moved into a comfortable house, had met Boswell had begun his happy friendship

with the Thrales, had founded with Sir Joshua Reynolds, the famous Club and had begun the series of visits and ramblings that reached their climax in the tour to the Hebrides. He had now become a public personage, often satirized and caricatured, but nevertheless a sort of British institution. At his morning receptions he drank tea in bed and declaimed between sips. At noon he would dine in a tavern, stay until late afternoon drink more tea at the house of a friend, and eventually retire supperless to his home to read and write far into the night.

Dr John Lettson says of him at this period, 'In company I neither found him austere nor dogmatical he certainly was not polite, but he was not rude. He was sometimes jocular but you felt as if you were playing with a lion's paw. His body was large, his features strong his face scarred and furrowed with scrophula. He had a heavy look but when he spoke it was like light ning out of a dark cloud.'

His last days were embittered by the death of Henry Thrale and by the defection of Henry's widow Hester. Apoplexy claimed the food-loving Henry and Mrs Thrale, probably Johnson's dearest friend, instead of centering her life around Johnson as he had expected, became infatuated with a young Italian singer named Pozzi, and was lost to Johnson as well as to English society.

Johnson was a robust man, but not a healthy one. He never knew a day's complete ease in his life. But in spite of his ailments, he had great muscular strength was a big eater and was capable of sitting up to all hours. When he was sixty he bathed in the sea at Brighton in October. At sixty five he had an attack of gout, and at sixty-seven he had another attack, together with difficult and laborous respiration for which he was hied rather heavily. The next year he said, 'The hand of time or disease is heavy upon me. I pass restless and uneasy nights, harassed with convulsions of my breast, and flatulencies of my stomach.'

At the age of forty-six he had had laryngitis, but no further respiratory diseases until he was sixty three, when he was plagued by a winter cough which recurred at intervals for some years. Venesection was the treatment. Asthma laid him low during the winter of 1781-82 and for the rest of his life he breathed with difficulty. Opium brought him great relief and his dose rose to three grains daily. But on his seventy-second birthday he thought he had more bodily strength and vigor than was common.

Dropsy was first noticed in 1783 by Sir Lucas Pepys. Diagnosis of sarcocele was made by Per-

civall Pott in consultation with William Cruikshank, and it was put up to Cruikshank to make an excision. But Cruikshank was afraid of operative shock, and while he delayed, "the sarcocele ran off at an orifice made for mere experiment." At seventy-four Johnson had a stroke. He wrote to Mrs. Thrale

"I went to bed, and in a short time asked and sat up as has long been my custom, when I felt a confusion and indistinctness in my head, which lasted, I suppose, about half a minute. I was alarmed, and prayed God that however He might affect my body He would spare my understanding. This prayer that I might try the integrity of my faculties, I made in Latin verse. The lines were not very good, but I knew them not to be very good, I made them easily, and concluded myself to be unimpaired in my faculties. Soon after I perceived that I had suffered a paralytic stroke, and my speech was taken from me.

He tried to treat himself with wine, thinking to rouse the vocal organs. Surprised at his own apathy he sent for Brocklesby and Heberden, who blistered him and gave him salts of hartshorn. Recovery from the hemiplegia and aphasia was rapid and complete.

Later in the year gout plagued him again, and he had an attack of spasmodic asthma of great violence that forced him to sit up all night. Dropsy became grave increasing to the thighs, and by February of 1784 was so extensive that Johnson had Boswell consult five Edinburgh physicians, including Cullen, Hope and Moore. The five, despite the disadvantage of long-distance prescribing, recommended squills, which Johnson took with such vigor as to produce unpleasant reactions. His only other remedy was rhubarb, then a rare and costly drug. He was aware now of precordial constriction on exposure to cold, and had to take tincture of laudanum for night dyspnea. "My diseases are an asthma, and a dropsy, and what is less curable seventy-five," he said.

About the middle of March, after a day of prayer and fasting, Johnson had a urinary crisis, passed twenty pints of urine and became free from the dropsy that had kept him indoors for over a hundred days. After a trip to Oxford and Lichfield which tired still further his already tired heart, the dropsy returned but was controlled by drugs and rest until November. In December the edema was so great that his legs were itched. To poor Cruikshank he cried, "Deeper deeper, I will abide the consequence. You are afraid of your reputation but that is nothing to me!" Still not satisfied that the incisions were deep enough, he got a lancet and cut himself again and then thrust a pair of scissors into the calf of each leg. Because of this action a rumor started that he had committed suicide.

When Dr. Warren expressed the hope that he was better the death-fearing Johnson bravely replied, "No sir you cannot conceive with what acceleration I advance towards death!" And when Dr. Brocklesby told him that there was no hope for him, he said, "I will take no more physic, not even my opiates for I have prayed that I may render up my soul to God unclouded. And so he died.

A post-mortem examination was performed in the Library of the Royal College of Physicians two days after death by Dr. James Wilson, Cruikshank and Heberden being present. The lungs did not collapse but remained distended apparently without the power of contraction. The air cells on the lung surface were much enlarged, and the right lobe adhered strongly to the diaphragm. No water was found in the thorax cavity. The heart was very large and the valves of the aorta were beginning to ossify. Not more than the usual amount of fluid was in the pericardium. Incipient peritoneal inflammation and ascites appeared in the peritoneum. The liver and spleen were large and firm, the spleen having almost the feel of cartilage. The gall bladder contained a stone the size of a pigeon's egg. The account also mentions "hydatids" in the right kidney and destruction of the left kidney with two very large hydatids formed in its place. These were probably common renal cysts, not distinguished from hydatids until 1793, when Matthew Baillie published his book on morbid anatomy.

The story is that of a man with good family history who acquired gout and a hypertension leading to a transient stroke. Emphysema aggravated the symptoms of heart failure. Rest, squills and opium brought some relief but too much travel brought on another attack, and death ensued.

Like many literary men, Johnson suffered much from impaired vision. Fanny Burney spoke of him as looking at the books in her father's library "almost touching the backs of them with his eyelashes as he read their titles. His short sight would explain his lack of interest in pictures, sculpture and architecture, just as his defective hearing would explain his lack of interest in music. According to Treves his poor vision was due to a leucomatous change in the cornea as a result of tuberculous keratitis, probably connected with the tuberculous glands in his neck. In spite of treatment, the sight of the left eye was lost. Johnson was very sensitive about his myopia and never wore spectacles. Twice in his life his right eye became inflamed from much reading of small print.

His gastrointestinal symptoms were probably the result of his erratic eating. His gallstone may have been pure cholesterol, but the adhesions found between the folds of the jejunum could have been caused by cholecystitis.

Some endocrine disorder may have produced his bulky form and massive features. Probably there was some degree of hyperpituitarism combined with some hypothyroidism. His hands were not unduly large.

A strong sense of inferiority could very well result from a childhood such as Johnson's. Scrofula and defective vision combined with a clumsy body kept him from mixing with other boys at games. His ego instincts could find outlet only in intellectual distinction. He no doubt found partial compensation, too, in fantasy and in the friendship of young handsome gay men like Beauclerk, for instance. His melancholy and his tics were marks of his frustrations. His melancholy he tried to mitigate by constant companionship—he had a morbid dread of being alone. His tics were only habit spasms or motor tics. As he walked along a street, he felt obsessed to touch certain posts, turning back if he missed one.

The suggestion has been made that Johnson was sexually impotent. To be sure he married

but his bride was an elderly widow, and he may have felt that he could marry her without doing her any injustice. Boswell says that he was invariably chaste, but also that his amorous side was very strong and that he used to take women to taverns in order to hear them relate their stories. This could have been an indirect method of sexual satisfaction. And his declared wish not to have children could have been a rationalization of his knowledge that he never could have any. Be that as it may, he certainly suffered from some inner emotional conflict which tormented him all his days.

He was buried in Westminster Abbey among the great of Britain—a true-born Englishman of the eighteenth century.

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## REVIEWS OF NEW BOOKS

THE book *British Surgical Practice* is the third in a series of volumes two of which have been reviewed previously. The subjects presented alphabetically, extend from "Caesarean Section" through Erythema.

Once again there is a profusion of illustrations throughout the book which are pleasing in their simplicity and add a great deal to the clarity of the work. The chapter on caesarean section is well outlined. In fact, the entire book continues what is hoped will be the practice throughout all the volumes namely that of supplying not only clear chapter and subchapter titles but also convenient marginal index labels. Perhaps the most significant part of the chapter on caesarean section is the full list of indications. In any discussion of this topic the indications come in for close scrutiny and apparently in all cases surgeons are subject to criticism should promiscuity be the practice. The usual varieties of the operation are outlined in a simple clear fashion, and the illustrations are well done.

It is interesting to note that an entire chapter is devoted to tumors of the carotid body. Recently in the United States, authorities have been outspoken in their frank admission of theories which have heretofore been held rather secret. Lahey is now emphasizing repeatedly and his lead is being followed by other authorities, that when such a tumor involves the great vessels in such a way that a sacrifice of the vessels will result in not only a high incidence of hemiplegia but also a forbidding mortality rate, such treatment is decidedly out of order. The author of this chapter agrees with the middle group of American surgeons who feel that only 50 per cent of such tumors are malignant in the first place. One will recall the argument used in this country today by some outstanding authorities that there is a possibility of malignancy in 50 per cent. The diagnosis of carotid body tumor is made quite evident, and the treatment suggested agrees very closely with that accepted at present in this country, namely that if exploration reveals too great a risk in considering removal, the surgeon should be satisfied with biopsy alone.

There is some general discussion on cellulitis, lymphangitis, erysipelas and so forth. This discussion is divided into two parts namely that on general infections and that on localizing infections, such as those in the pelvis. Chemotherapy is mentioned but there is a notable lack of discussion in regard to penicillin and streptomycin. One derives the impression that the chapter was written prior to the

general availability of the latter agents, although in the discussion of the cases of pelvic cellulitis it appears that penicillin has indeed come in for its logical usage.

A chapter on the cervical rib and the scalenus syndrome is complete and offers a good bibliography especially referring to the work of Adson.

Perhaps a bit out of place in this volume, from the viewpoint of the casual American surgeon, is the inclusion of a discussion of chemical warfare and its surgical aspects. Probably those persons who were not subject to the mass bombings would not be as apprehensive about the possibilities but one can appreciate the thoughts that must have gone through the mind of the British surgeon at that time. The discussion is timely and agrees well with the material promulgated during the recent war by not only the American army and navy medical departments, but also the civilian defense groups.

There is a separate chapter on chemotherapy which is delightful. The average volume on surgery would overlook such a handy outline. The selection of the various drugs is discussed, their methods of administration are rendered crystal clear, their toxic effects are pointed out and the beneficial results to be expected from the chemotherapeutic agents are discussed with frankness.

There is a section on coagulants and anticoagulants. The preliminary outline of the mechanisms of clotting and bleeding as well as a discussion of the prothrombin factors, is very timely. The various agents for coagulation are mentioned briefly with a short characterization of each. The reader is not told, but one gets the impression that perhaps in Great Britain these agents are employed more widely than they are at present in the United States. The anticoagulants, namely heparin and dicumarol, are given proper space. Fortunately there is a good list of references here which those seriously interested would do well to employ.

In the chapter on colitis the outstanding feature is the illustrations regarding various procedures to be used occasionally. Several types of colectomy and appendicectomy are stressed. Recently it has been stated in the United States by many authorities that "open operations" upon the colon itself have little place in cases of colitis. It is felt that since the disease is usually so generalized in the colon, the correct part of the intestine to be employed is the ileum. This is not made clear in the present volume. Ileostomy which is employed extensively in the United States comes in for a rather thorough discussion later in the chapter. The illustrations once again are very good and the technique is given thorough discussion. Fortunately there is also a discussion of the appliances that may be used, together with

BRITISH SURGICAL PRACTICE. Under the General Editorship of Sir Ernest Ross, F.R.C.S., F.R.C.P. and J. Paterson Ross, M.S., F.R.C.S. Volume 3. London: Butterworth & Co., Ltd. 81, Leadenhall Street, E.C. 3. 1948.

agents for protecting the skin. Apparently the British surgeons experience the same types of complication that we experience in this country namely, prolapse of the ileum, formation of abscesses and fistulas and intestinal obstruction. The writer is well advised in generalizing his statements in regard to colectomy in this disease. The exact time interval between ileostomy and colostomy remains controversial, although there is more and more tendency now toward uniformity. The possibility of carcinoma arising in the diseased colon is mentioned along with other complications which should remind the surgeon to resort to colectomy at the optimal time.

There is a rather long and complete chapter on carcinoma of the colon by no less an authority than Sir Hugh Devine. This offers almost all that the average practitioner needs to know about the field today. In addition to the thorough discussion of the clinical features of the disease, the various methods of dealing surgically with carcinomas located at different points of the colon are outlined. It is difficult to guess just when this chapter was written. The role of chemotherapy is given full credit and the failure of penicillin to be effective against the *Hadluis* coli is stressed. However the operative techniques seem rather old fashioned and in fact, in many centers in the United States today would be considered so. The so called extraperitoneal resection of the terminal part of the ileum and right portion of the colon leaving a double barreled stoma is now largely reserved for emergency use in this country. Actually the wide acceptance of one stage resection with primary anastomosis has been one of the most gratifying advances in this field of surgery. Devine admits that the modern adjuncts to preoperative care may indeed change the picture somewhat, but he expresses the opinion that these adjuncts are to be used to render his already safe operation even safer. His method of immediate anastomosis performed in low lying lesions of the colon always requires previous defunctionalization of the colon with its attendant complications prolonged morbidity and a factor which can be overlooked easily in the final analysis. A mortality rate which must be computed on a many stage operation. Even today the proponents of the multiple stage operation will quote a mortality rate which represents the resection only. All clinics are aware of the accidents admittedly uncommon which attend crushing the colostomy spur and in addition to this, the leaks which can be observed after an intraperitoneal closure of the colonic stoma. The controversy probably still rages but no one can deny that in the leading centers throughout the United States today qualified surgeons are so pleased with primary resection and immediate anastomosis (without the use of a vent or safety valve) performed in the selected case of the properly prepared patient that they are certain they will never have to return to the more obsolete method. Devine omits discussion of carcinoma high in the rectum but his views are so completely covered in his other articles to which he re-

fers in this chapter that the careful student will become quite familiar with it.

In a chapter on megacolon the treatment presented concerns itself entirely with sympathectomy. Certain authorities in this country notably Dixon are now teaching that resection of the involved intestine wherever possible will give a more satisfactory result.

There are many chapters dealing with items that can scarcely be of interest to the average surgeon, which will serve as a handy reference in an uncommon instance. These include conjunctivitis eye injuries, operations about the ear and labyrinth and so forth.

The chapter on diverticula of the alimentary tract is good in that it points out that almost the entire tract may be involved.

There is an interesting section on endometriosis which embraces several of the leading theories on the cause of this condition. The clinical picture is made rather clear cut and the treatment agrees with that taught in the United States. Of special importance is the author's advice to leave intestinal lesions alone unless there is actually acute obstruction since the intestinal lesions will regress after oophorectomy. The young surgeon will be well advised to leave alone those lesions which are too extensive to remove without damage to vital structures since termination of the ovarian function will control the disease. In the author's words: "There is no justification for attempting to eradicate the disease if the operation is likely to endanger the patient's life. The last of references for this topic is disappointingly short."

There are some chapters devoted to aids to diagnosis which include peroral endoscopy as well as cystoscopy and sigmoidoscopy. The trend in the United States today is toward collaboration in diagnosis since every field is now so complicated and intricate that it is difficult for any one man to master all of the modern ramifications of all fields. Therefore, a busy surgeon may do well to seek diagnostic help from a qualified colleague when it comes to the expert manipulation of an instrument which must be applied in what is admittedly a blind procedure. This world literature is notably lacking but the memories of the older surgeons are replete when it comes to recalling distressing and even fatal accidents which have occurred in the injudicious use of these blind procedures.

E. S. JUNG, JR.

THE third edition of *Control of Pain in Childbirth* is considerably enlarged and improved. There are now 352 pages as contrasted with 356 pages in the first edition. Special attention is paid to the technique of caudal and continuous caudal analgesia, spinal and continuous spinal analgesia, and the saddle block spinal analgesia. There is also a discussion of the use of demerol during labor.

*CONTROL OF PAIN IN CHILD BIRTH.* By Clifford B. Lull, M.D. F.A.C.S., F.I.C.S., and Robert G. Hingston, M.D. F.I.C.S., F.A.C.A., F.I.C.A., with an introduction by N. W. Vaux, M.D. 3rd ed. Philadelphia: J. B. Lippincott Co., 1948.



The arrangement of the chapters is essentially the same as it has been. The last 25 pages of the text are devoted to an interesting article on "An Analysis of Newborn Mortality and Morbidity With Controls in New York, Philadelphia, and Memphis with Continuous Caudal Anesthesia" which was written by Hingson, Edwards, Lull, Whitacre and Franklin. Many new illustrations and charts have been added.

This book is useful because it contains a huge amount of valuable data which are analyzed in an unbiased manner. Likewise there are included in the book several sections prepared by collaborators who are experts in special methods of administering pain relief to women in labor. This book is highly recommended to all who are interested in obstetrics and anesthesia.

J. P. GREENHILL

## CORRESPONDENCE

### SUBMUCOUS LIPOMA OF THE COLON — A Correction

A LETTER from Dr. Charles W. Mayo advises that an error was made in the manuscript for the article entitled "Submucous Lipoma of the Colon" by himself and Dr. Donald F. Cries in the March 1949 issue of SURGERY GYNECOLOGY AND OBSTETRICS. Paragraph 3, page 309 should read as follows:

Comfort reported 25 cases of submucous lipoma of the gastrointestinal tract, most of which were found at necropsy. However, there were 3 cases in

which operation had been performed prior to 1928. In these 3 cases, 1 lipoma was situated in the sigmoid, 1 in the hepatic flexure and 1 in the ascending colon. Pemberton and McCormack reported 3 additional cases of submucous lipoma in which operation had been performed between 1928 and 1936. In this series, 1 of the lipomas was situated in the hepatic flexure, 1 in the descending colon and 1 in the ascending colon. The 20 cases which we are reporting in this paper make a total of 25 in which operation was performed at the Mayo Clinic up to and through the year 1947. Some of the cases in this total series have been reported individually previously.

## BOOKS RECEIVED

Books received are acknowledged in this department, and such acknowledgment must be regarded as sufficient return for the courtesy of the sender. Selections will be made for review in the interests of our readers and as space permits.

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SEEKING THE EYE. By Meyer Wiener, M.D. 2d ed. New York: Grune & Stratton, 1949.

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May, 1949

**SURGERY**  
**GYNECOLOGY AND OBSTETRICS**  
*Supplement*

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Various other types of nails, pins, screws, and bolts are used by the other 18 surgeons (5 20 22 31 33 34, 36 51 59, 60 62 79, 80, 83 86 87 88, 103 105 106 120 133, 140 142 143 149 and 163).

When the fracture is impacted in the abduction type, some operators use a conservative splintage without operation (38 50 57 78 and 108).

La Ferte performs a McMurray type of osteotomy for all fresh fractures of the femoral neck.

As mentioned an attempt has been made to anticipate those fractures which will not heal because of the plane of the fracture line through the femoral neck. It is believed that when the fracture tends to be vertical, that is, parallel with the long axis of the shaft of the femur the prognosis for union is bad even with accurate reduction and proper pinning of the fragments. Accordingly some surgeons are now performing an immediate osteotomy with or without internal fixation for this type of fracture (13 68 73 85, 109 112 and 147).

*Results of operation for femoral neck fractures.* Boyd and George (15 15a) reviewed 360 cases of fracture of the neck of the femur treated by operation, and found a mortality of 7 per cent, bony union in 84.7 per cent, and aseptic necrosis of the femoral head in 60 per cent of the patients with nonunion and in 33 per cent of those with union. These authors state that internal fixation is the treatment of choice for acute femoral neck fractures, because the mortality is lower the patient is more comfortable medical complications are less frequent, the percentage of senile psychosis is greatly reduced, the cost of hospitalization is diminished and the percentage of bony union is greater than with any other method."

#### EXTRACAPSULAR (INTERTROCHANTERIC) FRACTURES

It has previously been thought that intertrochanteric fractures of the femur should be treated by traction or other conservative methods (7 89 and 138).

While nonunion of intertrochanteric fractures rarely occurs, malunion commonly occurs. Further the mortality for intertrochanteric fractures is higher than that for femoral neck fractures (18 32, and 119).

*Operative treatment of intertrochanteric fractures.* One hundred and four replies to the questionnaire concerning the treatment of intertrochanteric fractures were received. Eighty three of the orthopedic surgeons prefer to treat intertrochanteric fractures of the femur by internal fixation. Twenty six of these 83 use the Smith-Petersen nail and the

Thornton plate (10, 13, 39, 43, 52 65 66, 67, 77 78 82 84, 96 102 107 109 114, 117 125 130, 147 154, 160 and 164) 20 use the Nail (21 40, 47 54, 55, 56 90, 93 94, 95, 99, 111 119 137 140, 143 144 150a, and 156) 2 use the Moore-Blount blade-plate (8 9 11 42 45 46 49 57 58 61 62 72 74, 79 83 85 91 101 105 108, 124, 133 136 141 142, and 162) 3 use the Smith Petersen nail and the McLaughlin plate (97 98, and 126) and 6 use the Jewett nail (14 23, 26 26a, 38 71 88 122 and 127).

*Nonoperative treatment of intertrochanteric fractures.* Twenty-one surgeons prefer conservative treatment of intertrochanteric fractures.

The most popular type of conservative treatment is skeletal Russell traction (4 6, 41 70, 89, 112 115 132 138 155 157 and 157a). Other forms of external fixation used are the Roger Andersen well leg splint (113 121, and 161) Thommason double leg plaster cast (18) Buck's extension (20) pantaloons cast (32 34) Wilkie boots (37) the Whitman cast (152) and the hang leg cast (118).

*Results of treatment of intertrochanteric fractures.* From a study of 133 consecutive cases of intertrochanteric fractures of the femur 38 of which were treated by traction and 95 by internal fixation, Cleveland Bosworth, and Thompson (26, 26a) found that (1) internal fixation reduced the hospital mortality to 12.6 per cent as compared to 34 per cent after treatment in traction and (2) severe senile mental deterioration occurred in 2.7 per cent of the patients following internal fixation as compared to 11 per cent of the patients treated by traction.

O'Brien, Shy and Bablis (110) reviewed 103 consecutive cases of patients with trochanteric fractures of the femur treated by operation and internal fixation, the most commonly used agent was the Neufeld nail-plate. The mortality was 21.4 per cent. Follow-up examination of 50 patients revealed excellent results in 74 per cent.

*Nonunion of fractures of the femoral neck.* The value of early and accurate reduction of these fractures by the proper application of the internal fixative agent and the prohibition of weight bearing until evidence of union on roentgen-ray examination has been manifested, and the incidence of nonunion has been decreased. To secure the best results, the following principles, expressed by Thomson should be kept in mind

1. The hips must be quite accurately reduced.
2. If the head is in a little valgus with the neck, our ratio for success is better.
3. A very long pin which will pass almost straight up from the shaft well into the head

through the lower portion of the neck gives more secure fixation than any other method.

However nonunion of femoral neck fractures still presents a big problem. According to Boyd and George (15), Cleveland (23) and Dickson (39a) 13.5 per cent, 16 per cent and from 18 to 20 per cent, respectively, of the fractures of the femoral neck operated upon go on to nonunion.

The majority of surgeons corresponded with prefer to perform a McMurray type of osteotomy, most of them fixing the fragments with a blade-plate (11) for nonunion of femoral neck fractures when the femoral head is alive (3, 10, 11, 12, 13, 14, 38, 40, 41, 42, 43, 44, 50, 51, 52, 54, 56, 58, 63, 64, 65, 67, 70, 72, 73, 75, 77, 82, 84, 85, 90, 92, 95, 96, 100, 101, 102, 105, 109, 112, 114, 117, 120, 121, 126, 128, 130, 137, 138, 139, 141, 144, 146, 151, 157a, 160 and 161).

Other types of operation which are in use are bone grafting with or without pins (1, 4, 21, 34, 83, 122, 132, 140 and 164), the Brachett reconstruction operation (16, 49, 93 and 107), Shantz osteotomy (39, 78, 123 and 124), Leadbetter osteotomy (99, 131, 156 and 159) and the Whitman reconstruction operation (81, 133 and 163).

McLaglin (98) writes, "Many patients with failure of bony union need no treatment. A patient with fibrous union provided the pain is not too severe may be able to get around with a cane or a walking caliper brace."

**Aseptic necrosis of the femoral head.** Aseptic necrosis of the femoral head occurs most commonly after nonunion of femoral neck fractures but also develops after union of the fragments.

Boyd and George (15a) found the incidence of aseptic necrosis of the head of the femur to be 31.6 per cent among the patients that obtained union, while 59.3 per cent of the hips with non union showed aseptic necrosis.

Aseptic necrosis or degenerative arthritis of the femoral head after union of the femoral neck fracture has occurred should be treated by the prevention of weight bearing on the extremity to give the femoral head an opportunity to regenerate. Aseptic necrosis of the femoral head associated with nonunion of the intracapsular fracture of the neck of the femur is probably best treated by one of the reconstruction operations or arthrodesis of the hip joint.

The operative procedures now used for this condition are the Whitman reconstruction operation (71, 84, 95, 128, 146, and 153), the Colonna reconstruction operation (27, 28, 62, 102 and 126), the McMurray type of osteotomy (13, 55, 116 and 140), vitalium mold arthroplasty (4, 10, 55 and 135), and trochanteric arthroplasty (158).

## SUMMARY

Internal fixation is the treatment of choice for intracapsular and extracapsular fractures of the neck of the femur. The Smith Petersen nail is used by most orthopedic surgeons for the internal fixation of femoral neck fractures. The Smith Petersen nail, the Neufeld nail blade, and the Moore Blount blade plate are used most frequently in the operative treatment of intertrochanteric fractures.

The early operative treatment of femoral neck fractures with accurate reduction of the fragments and prohibition of weight bearing until bony union has taken place will probably reduce the incidence of nonunion of the fracture and of aseptic necrosis of the femoral head. Immediate osteotomy for the vertical type of femoral neck fractures may be the answer to this problem.

The McMurray type of osteotomy usually with the blade-plate to fix the fragments is most generally used for treating nonunion of femoral neck fractures.

There is no generally accepted operative procedure for the treatment of aseptic necrosis of the femoral head.

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# ABSTRACTS OF CURRENT LITERATURE

## SURGERY OF THE HEAD AND NECK

### HEAD

**Tumors of the Lower Jaw** (Tumores da mandíbula)  
Mário Kroetz and Alvaro Coutinho *Rev. Br. Stomatol.* 1947 5.

The following classification of tumors of the mandible adopted by the National Cancer Service of Brazil, is offered by the authors:

1 Tumors of dental origin (a) odontogenic cyst follicular radicular or periodontal (b) adamantinoma (c) odontoma.

2 Mesenchymal tumors (a) fibroma, (b) chondroma, (c) osteofibroma, (d) osteoma, (e) sarcoma fibrosarcoma, chondrosarcoma, osteogenic sarcoma or reticulosarcoma (F) giant tumor or myeloid sarcoma.

3 Myeloplaxoma

4 Myeloma

5 Metastatic tumors epithelial or mesenchymal

6 Pseudotumors (a) fibrous osteitis Recklinghausen's disease Paget's disease or osseous leontiasis, (b) lymphogranulomatosis (c) osteomyelitis (d) syphilis, (e) tuberculosis.

Of 9030 patients, 44 had primary tumors of the lower jaw. The histologic examination established the diagnosis of a giant cell tumor in 21 cases, adamantinoma in 6, odontogenic cyst in 5, fibroma in 18, osteoma in 1 case and osteomyelitis in 3 cases.

The case histories are well illustrated.

The authors advocate the treatment of tumors of the jaw with electrocoagulation, by the so-called Kroetz technique. The coagulated bone segment is left *in situ*. As a rule, the sequestrum is eliminated spontaneously in about 8 weeks, which leaves a bridge of fibrous tissue that gradually becomes ossified. This type of treatment is employed by the authors in the majority of primary and secondary tumors of the lower jaw. *JOSEPH K. N. R. M.D.*

### EYE

**Sidelights on the Inferior Oblique Muscle** J. RAY-  
LARD ANDERSON. *Br. J. Ophth.* 1945 3 655.

In the first portion of this article the author considers the anatomical features of the inferior oblique muscle and discusses in considerable detail the relationship of this muscle to the inferior rectus muscle. The sheaths of the muscles are most important in relation to surgery.

In the second portion he discusses the surgical approach to the muscle both for myomectomy and recession. The insertion of the muscle is not always constant as considerable variation has been noted.

Overaction of the inferior oblique muscle may be due to (1) asymmetry in the balance or in insertions

of the superior or inferior oblique muscles and (2) secondary overaction due to paresis of the homolateral superior oblique or contralateral superior rectus muscle.

The diagnosis is best made by the cover test and in various fields.

The treatment for overaction is broken down into several types: (1) tenotomy at source of the muscle, (2) tenotomy at insertion of the muscle, (3) recession at insertion of the muscle, and (4) altered insertion of the horizontal rectus muscles.

Weakness of the inferior oblique muscle is then considered and treatment is outlined as follows: (1) strengthening of the affected muscle by advancement at its bony origin, (2) making a tuck or resection at the insertion of the muscle, (3) weakening of the contralateral yoke muscle and (4) weakening of the homolateral antagonist muscle.

Large horizontal errors must be corrected before the critical defects are attacked.

Accurate diagnosis is necessary for satisfactory treatment. *ERNEST H. MARR, M.D.*

**Osteoma Involving the Orbit** FRANK W. NEWELL  
*Am. J. Ophth.* 1945 31 123

The author discusses osteoma involving the orbit. An osteoma frequently originates in the nasal accessory sinuses and may invade the orbit (resulting in ocular disability) before localizing signs appear in the sinus.

Ocular involvement occurs most frequently when the original growth is in the sphenoid or in the ethmoid sinus, less commonly when in the frontal, and rarely when in the maxillary sinus.

Osteomas are hard glistening rounded tumors which present numerous facets that follow the outlines of the sinuses and other structures against which they impinge during growth. They may be sessile or pedunculated. They may be quiescent for long periods of time or become very large without symptoms. The tumors are covered with normal peritoneum which extends into the substance of the growths. There are 3 main classes of true osteomas: the eburnated (ivory hard), the compact (resembling normal bone) and the spongiouse (the most immature type).

Osteomas should be distinguished from bony hyperplasia of the bones of the skull which occurs as hyperostosis in dural endothelioma. In the latter the marrow spaces of the bone are filled with tumor cells the invasion of which causes the bony overgrowth.

The symptoms and signs of osteoma are cerebral, nasal and ocular and they depend upon the site of origin. Cerebral disturbances include mental de-

iciency, vertigo various sensorimotor disturbances, convulsions cerebral pneumatocele, and increased intracranial pressure.

Intracranial difficulties are usually produced by sphenoidal growths. Occlusion of a sinus (with resultant infection) usually occurs with tumors of the frontal sinus. Anosmia indicates cerebral extension with involvement of the olfactory nerve.

Ocular signs are usually associated with ethmoidal and sphenoidal tumors. Extension into the orbit usually results in progressive exophthalmos. Sphenoidal osteomas may affect the optic nerve and result in optic atrophy papillitis or papilledema. An ethmoidal tumor may produce papillitis generally attributed to involvement of the blood supply to the optic nerve.

The diagnosis is based on roentgenographic evidence of a well circumscribed bony tumor originating in a sinus and the absence of increased thickness of other bones of the skull. Diagnosis of osteoma of the frontal or maxillary sinus is simple diagnosis of a sphenoidal tumor rests on microscopic study of the tumor because a dural endothelioma may produce a similar picture. This also applies to tumors originating in the ethmoid sinuses although a localized bony tumor at this site without hyperostosis of the roof of the orbit or sphenoid ridge is most likely an osteoma. Moreover dural endotheliomas occur after while benign osteomas frequently occur before the age of 30 years.

Seven cases are presented in 2 of them the tumors originated in the ethmoidal sinus in 1 in the sphenoidal body and in 4 in the frontal sinus. The tumors arising from the ethmoid were successfully removed, the tumor arising from the sphenoid was considered inoperable. Death resulted from internal hydrocephalus.

JOSHUA ZUCKERMAN, M.D.

**The Present Position of the Problem of the Intracocular Fluid and Pressure.** SIR STEWART DUXE ELDER and H. DAYSON *Brit. J. Ophth.*, 1943, 32: 553

The authors discuss the nature of the aqueous humor and the present position of the problem of the intraocular fluid and pressure. It appears that the intraocular fluid is more than a simple dialysate in equilibrium with the capillary plasma. This is confirmed by a study of nitrogenous substances urea penetrates more slowly than glucose although it has much the smaller molecule. The chemical composition of a substance is more important as a determinant of rate of penetration of the barrier than is its molecular size. Whatever cellular activity is present is localized in the lining epithelium of the eye mainly in the ciliary region.

The actual mechanism is more complicated than dialysis it differentiates between substances on a chemical basis, and the blood aqueous barrier differs in different localities of the eyeball. In the case of sugars entrance into the anterior chamber through the iris is easy entrance into the vitreous is slower. Certain substances, e.g., sodium and potassium enter

the vitreous from all parts of its periphery by way of the choroidal and retinal circulations. This finding reveals the analogy between the capillaries of the cerebral and those of the retinal vascular systems.

Although the simple dialysis theory appears to be wrong the fairly close similarities in chemical composition of aqueous humor and plasma indicates that the simple physical factors of diffusion and osmosis are operative. Some degree of multidirectional permeability and the capacity for maintaining concentration gradients exist. The energy necessary for such modifications depends upon a difference of potential between the ciliary stroma and epithelium by oxidative and reductive processes due to the presence of the respiratory enzyme in the latter. This activity of the ciliary epithelium as a result of the excess of pressure results in a driving pressure of fluid into the eye. Fluid is forced into the eye with a pressure-head of from 50 to 75 mm. Hg. Because there is no counterpressure the intraocular pressure must equal this driving pressure unless there is a leakage of fluid out of the eye.

An alternative theory is the following the aqueous may be elaborated entirely within the cells of the ciliary epithelium and possibly in other cellular linings of the eye. The fluid is extruded into the posterior chamber as a primary aqueous humor. If completely developed the aqueous would appear to be a simple dialysate in spite of its secretory origin. However the aqueous humor does not remain in the eye long enough for this diffusion equilibrium to be established but an intermediate state is achieved. In this state it has strong characteristics of a dialysate betraying its secretory origin namely an osmotic pressure greater than that of the plasma, a higher concentration of sodium and chloride than required of a dialysate, a low concentration of urea, and a high concentration of ascorbic acid.

It is concluded that in the present state of our knowledge no final conclusion can be reached. More extensive and detailed experimental work is necessary.

JOSHUA ZUCKERMAN, M.D.

**A Contribution to the Microscopical Anatomy of the Sympathizing Eye.** R. AYLICK GREENE. *Brit. J. Ophth.*, 1943 32: 545

The author describes the microscopic anatomy of the sympathizing eye. He points out that the character of the histologic changes is not identical in exciting and in sympathetic eyes.

He presents 13 sympathizing eyes in all of which the original perforating injury to the exciting eye was an intraocular operation. He found that the character and distribution of the inflammatory changes in the various parts of the sympathizing eyes are not related to the duration of the disease. Neither is there any relationship between the length of time elapsing between the injury to the exciting eye and the onset of inflammation in the sympathizing eye.

In 7 cases the infiltrating inflammatory cells were lymphocytes and plasma cells in 6 cases there were



epithelioid cells and in 5 of the latter there were giant cells.

Iridocyclitis was the constant common factor in all cases. The choroid was found to be normal in 5 cases, while in 6 cases there were areas of infiltration consisting of lymphocytes and plasma cells only. Epithelioid cells occurred in the choroid in 3 cases and giant cells in only 1 case. The areas of choroidal infiltration consisted of localized patches in the outer layers of the choroid; the capillary layer was free except in one case in which the whole thickness of the choroid was involved. The posterior section of the choroid immediately surrounding the optic disc was consistently the most densely infiltrated part. Both findings are in accordance with the conditions usually found in exciting eyes. These are salient characteristics of sympathetic diseases.

In most cases there were some inflammatory cells in the vitreous. The optic nerve was normal in 5 cases and edematous in 8 in which the sheaths of the central vessels showed lymphocytic infiltration. The sheath of the optic nerve was infiltrated in 1 case only and the sheaths of the ciliary vessels were infiltrated in 4 cases.

Sporadic rupture of the lens was found in 3 cases. Organized plastic exudate in the anterior chamber occurred in 3 cases. In none of the cases did the infiltration in the iris reveal any particular tendency to be situated in the posterior layers, and there were no Fuchs-Dalen bodies.

Greeves concludes that on microscopic examination no special characteristic of the sympathetic inflammatory process is found invariably in the sympathizing eye.

JOSUUA ZUCKERMAN M.D.

## EAR

The Development of the Auditory Ossicles, the Otic Capsule, and the Extracapsular Tissues. BARRY J. AMSON, THOMPSON H. BART, and EARL W. CAULDWELL. *Ann. Otol. Rhinol.* 94:2, 57-603.

Concurrent steps in the morphogenesis of the ossicles, otic capsule, and pericapsular portions of the temporal bone were studied in serial sections of 300 temporal bones.

In the otic capsule, the first of 14 ossification centers appears early in the fourth lunar month (120 mm. C.R.). These centers fuse to form a complete capsule prior to the middle of intruterine life (155 mm.). Thus, adult dimensions of the capsule are attained at approximately the same time the stapes attains full size. Growth is precluded by the fusion of the numerous centers of ossification between which there occur no zones for epiphyseal expansion. However the otic capsule is not yet histologically mature nor is it embedded in the extracapsular osseous tissue which lends typical form to the so-called petrous portion of the temporal bone.

Of the three layers of the capsule, the inner or endosteal, stratum is the simplest. It forms a mere shell for the labyrinthine canals, cochlea, and vesti-

bule. It is complete at midterm and undergoes a further increase in size.

The outer periosteal layer appears in the cochlear region of the capsule during the eighteenth week (147 mm.) and is complete before the eighth month (246 mm.). In the canalicular part of the capsule it appears later (183 mm.) and spreads beyond its limits of the original capsule, toward the mastoid region. It continues to expand as an extracapsular addition, until puberty.

Of the three layers the middle (intracapsular and endochondral tissues combined) is the most complex in structure. In both cochlear and canalicular divisions of the capsule intracapsular bone appears in the 147 mm. fetus; this immature osseous tissue attains maximum distribution within a period of about 6 weeks after primary appearance (in the 215 mm. fetus). Around the cochlear intracapsular bone retains fundamental form up to the 246 mm. stage. Thereupon the formation of endochondral bone is initiated as a thin deposit over the islands of intracapsular tissue without other alteration of the spicules upon which deposition of the replacement bone takes place. At term the process is suddenly accelerated continuing through early infancy with such alacrity that the cochlear region resembles closely that of an adult bone. In the region of the canals there is no such initial lag in development. The deposition of endochondral bone around the canals is rapid up to the stage of 7 or 8 months (270 mm.), with subsequent slow deceleration. Activity begins in the region of the superior semicircular canal followed by the posterior and lateral canals; the intervening tissue is the last to be formed in endochondral bone.

The intercanalicular area never becomes converted into bone of fully petrous character. It retains marrow spaces which may persist in the adult ear or may be replaced beginning in the seventh month (216 mm. stage) by pneumatic spaces which spread from the tympanic antrum. When such occur invasion by mucous membrane progresses so rapidly as to be complete in the young child (3 years old). Except for this portion of the capsule, pneumatization is restricted to bone of periosteal nature which was added peripherally to the primordial osseous capsule. In other words, except in the territory named, the process of mucosal invasion leaves untouched that portion of the capsule which existed in the midterm fetus.

In the interval between periosteal and endosteal layers where marrow might be expected to occur, such tissue is usually replaced by bone of endochondral character thereby rendering the capsule relatively solid, or petrous. The interstices are subsequently invaded by mucous membrane derived from the tympanic cavity. Concurrently periosteal bone, added to the capsule in the latter half of fetal life is similarly invaded to form the air cells of the apical and related portions of the temporal bone.

After branchial inception of the auditory ossicles, cartilaginous growth occurs rapidly. At 28 mm. the

incus is separating from the malleus and the stapes has become independent of Reichert's cartilage. Single ossification centers first occur in the incus at 117 mm in the malleus at 126 mm and in the stapes at 146 mm. Endochondral ossification proceeds rapidly in the malleus and incus with none of the remoulding of contour observed so dramatically in the stapes.

The ossicles form without epiphyseal areas of growth, and therefore do not increase in size after bone becomes continuous around their peripheries. During ossification the stapes becomes hollowed at the capital and basal extremities, and channelled throughout the entire length of each crus. Vascular marrow gradually retreats before the advance of the tympanic mucous membrane. Endochondral bone persists only on the internal aspect of the head and base, forming a thin plate lining the 'articular' cartilages. The ossicles attain full dimensions near the middle of intrauterine life and possess adult form by the thirty-second week or 190-mm. stage.

EARL W. CAULDWELL, M.D.

An Experimental Study of the Toxic Effects of Streptomycin on the Vestibular Apparatus of the Cat. The Central Nervous System. JULES WINSTON F. H. LEWIS AND P. PARCETEAU. PHILIP A. MARDEN, and FAITH B. CRAMER. *Ann. Otol. Rhinol.*, 1948, 57, 738.

A destructive effect upon the vestibular function is the most important toxic reaction of prolonged therapy with streptomycin. Various authorities mentioned in this article disagree as to whether the lesion causing this effect is located in the central vestibular nuclei in the brain stem, in the peripheral vestibular end-organ, or in both of these places. The author has carried out three entirely different methods of investigation on cats whose vestibular apparatus had been destroyed by toxic doses of streptomycin and each of these methods has disclosed evidence of central damage. He is now engaged in investigating whether there is concomitant damage to the peripheral end organ. All of the experiments appear to be adequately controlled.

The first experiment is based upon the fact that damaged but not normal brain cells have an affinity for n stain (trypan blue) when injected intravitaly into the carotid artery. In this experiment the control cats showed no staining of any of the tissues of the central nervous system. The cats whose vestibular apparatus had been destroyed by streptomycin showed staining Purkinje cells of the cerebellar cortex dentate, and fastigial nuclei and the medial and lateral vestibular nuclei. A slight amount of dye was found in the ventral cochlear nuclei.

The second experiment is founded upon the fact that surgical destruction of the right vestibular nuclei will result in an uncompensated nystagmus to the left. Additional surgical destruction of the right vestibular nuclei but not of the right vestibular peripheral apparatus will completely and permanently eliminate this nystagmus. After surgical de-

struction of the right vestibular nuclei all control cats developed nystagmus to the left but all cats that had been treated with streptomycin did not develop nystagmus. This experiment definitely limits the destructive effect of streptomycin to a solitary destruction in the vestibular nuclei or possibly destruction to both the vestibular nuclei and the vestibular end-organs.

The third method of investigation consists of the examination of brain sections stained with phosphotungstic acid and cresyl violet. The controls showed no pathologic changes. Animals treated with streptomycin showed pyknosis and increase of glial fibers around the dendrites of the Purkinje cells of the cerebellum in 4 out of 6 animals. There was no destruction in the other 2. The temporal bones of these animals are now being examined to determine the presence of lesions in the peripheral end-organs.

WILLIAM K. WRIGHT, M.D.

## NOSE AND SINUSES

Rhinocleroma Apparently Cured with Streptomycin. GORDON B. NEW, LYLE A. WEEB, DONALD R. NICOLAS, and KENNETH D. DEVINE. *Ann. Otol. Rhinol.* 1948, 57, 412.

Rhinocleroma is a chronic granulomatous process involving the nose, upper lip, mouth, and upper air passages. It is believed by many to be an infection but it is only slightly if at all, contagious. An organism of the genus *Klebsiella* may usually be isolated from such patients. The chronic progressive clinical disease of rhinocleroma has not been reproduced in animals but the organisms are always present in the tissue of patients with this clinical manifestation. The organisms are usually seen in the large phagocytes and are easily grown in an artificial culture medium. Organisms with similar cultural features are frequently isolated from the respiratory tract of normal persons.

The disease was once thought to exist only in central and southeastern Europe, but it now occurs anywhere, and its incidence in South and Central America seems to be increasing. According to Cunningham and Gentry a total of 102 cases had been reported in the United States and Canada by 1942; 16 of the patients were native born.

Clinically there is at first an insidious growth of hard smooth nodules in the anterior nares. This growth spreads gradually until in many cases protruding, rounded smooth masses with intact skin surfaces close the nostrils. From the anterior part of the nose the lesion spreads backward into the pharynx, larynx, and trachea, and even into the bronchi. It may extend forward onto the upper lip or involve the cheeks, gums, antrum, lacrimal ducts, soft and hard palates and tonsils. Because of the presence of these masses function is impaired and such symptoms as foul nasal discharge, nasal obstruction, deafness, tinnitus, hoarseness and difficult breathing may ensue. Tracheotomy is often necessary. The disease is limited to the mucous

membrane and skin, ulceration is the exception and not the rule and constitutional symptoms are rare.

Up to the present no satisfactory method of treatment has been available. Therapy with roentgen rays or radium is, at best, palliative and must be repeated as recurrence of the disease dictates. Sulfanilamide and its derivatives seem to control the secondary infection, but have no effect on the scleromatous tissue.

Recently a patient with rhinoscleroma was treated at the Mayo Clinic with streptomycin.

This patient with rhinoscleroma is the first to be reported as probably cured with streptomycin, as far as the authors know. At the time of the original examination since the airway was partially obstructed it was thought that tracheotomy would be necessary as much of the granulomatous and scar tissue in the larynx and trachea as possible would then be removed and replaced with a skin graft, and later with an obturator in order to maintain an opening. The use of streptomycin cleared up the granulomas and also eliminated *Klebsiella* from tissue taken subsequently for biopsy. This evidence adds to the general impression that *Klebsiella* is an etiologic factor in the disease.

### NECK

**Clinical and Experimental Research on Thyro-Inhibitory Substances. The Employment of Sulfis Derivatives in the Continuous Medical Treatment of Hyperthyroidism (Ricerche clinico-sperimentali sulle sostanze tiroinibitrici. L'impiego dei sulfamidici nel trattamento medico continuativo dell'ipertiroidismo.)** LUIGI PARODI and MAXIMO DE GASCOI. *Arch. Ital. Clin.* 94:3, 70: 69.

The major portion of this article consists of a detailed review of the history, clinical application, influence on the symptoms of hyperthyroidism, contraindications, toxic manifestations, late results, and methods of action of thyroinhibitory drugs as gleaned from the literature.

The authors then present their own experiences with 3 patients who varied from 30 to 60 years in age and who were classified as follows: 1 with Flajani-Basedow's disease, 4 with hyperthyroidism and 5 with secondary thyrotoxicosis. The condition in 12 patients was considered grave and in 9 moderately grave when first seen. Most of the patients had received iodine therapy previously. Before treatment was begun the subjects had a complete blood count, basal metabolism test and blood chemistry tests for sugar, urea, and cholesterol. Aminothiazole was used in 5 cases and methylthiourea in the remainder. While therapeutic doses were being given, the complete blood count was repeated weekly and the other laboratory tests were made every 2 weeks; these determinations were made less frequently during the period of maintenance. Electrocardiograms were taken only of patients who presented thyrocardiac symptoms. Eleven of the patients were hospitalized. At the time of writing, 16 patients had

finished with a complete course of treatment and the medication had been stopped for from 2 to 12 months. The results were considered to be very good in 5, good in 4, and mediocre in 3; 5 patients had a recurrence of hyperthyroidism. One third of the total number of patients developed toxic manifestations, including arthralgia, nausea and vomiting, exanthemas, fever and subicterus. There was only 1 instance, however, wherein the drug had to be stopped. This was for severe leucopenia. Three patients who did not respond well to medical therapy were also treated by irradiation of the hypophysis, with 600 roentgens divided into 6 weekly doses. All 3 responded well thereafter. The essential data for all 31 cases are clearly presented in table form.

In general, the authors conclude that:

1. Methylthiourea and aminothiazole have demonstrated a specific curative effect against a large portion of the morbid components of Basedow's disease, particularly in respect to neuropsychic and cardiovascular symptoms and weight loss.

2. These drugs have little or no effect on exophthalmos nor on the final size of the thyroid gland.

3. There are wide individual variations in the therapeutic response to these drugs, but there is no relation between these various responses and the type, duration, or gravity of the disease, or the age or sex of the subject.

4. Methylthiourea has a more potent therapeutic action and is more likely to result in toxic manifestations than aminothiazole.

5. Irradiation of the hypophysis is a valuable adjunct in some subjects who demonstrate a poor therapeutic response to the drug alone.

As a final definitive treatment for hyperthyroidism as compared to thyroidectomy, these drugs have been used in too few cases by the authors and the patients treated have not been followed up long enough to make a decision in favor of medical treatment. However, the authors state that this form of therapy is usually not indicated in toxic adenomas of the thyroid.

N. CHRISTIAN MEYER, M.D.

**The Association of Carcinoma of the Thyroid Gland and Exophthalmic Goiter.** JOHN DEJ. FARMER, TORO and B. MARSHALL BLACK. *Surg. Clin. N. America*, 94:8, 8: 935.

Carcinoma of the thyroid gland occurs occasionally in association with exophthalmic goiter. In a series of cases of carcinoma of the thyroid gland collected from the literature, 1.75 per cent of the malignant lesions were associated with exophthalmic goiter. At the Mayo Clinic, 0.4 per cent of thyroid glands removed because of exophthalmic goiter from 1916 through 1946 contained coincident carcinomas. A total of 3 such cases have been encountered at the clinic. In 15 of the cases the malignant lesions had evidently not originated in an adenoma while in 7 cases the carcinomas had developed in adenomas. The great preponderance of low grade, slowly growing carcinoma in the series, and the fact that in only 1 of the 22 patients had the carcinoma produced

symptoms suggests that the malignant lesions could well have developed before the onset of the exophthalmic goiter in most cases. At least this explanation of the preponderance of low grade lesions seems more acceptable than the belief that the hyperplastic or hypertrophic cells give origin almost exclusively to papillary malignant lesions. The finding of a carcinoma in the thyroid gland of a patient who has received goitrogenic drugs or radiolodine does not imply an etiologic relationship between the drug and the malignant lesion.

**Hemorrhage in Deep Infections of the Neck: A Review with Report of 2 Cases.** MAURICE D. GRANT and GOODLATTE B. GILMORE. *Arch. Otolaryng.* 1948 47 446

The authors review the etiology and the anatomy of deep infections of the neck. They call attention to the fact that the layers of deep cervical fascia define certain potential spaces which become actual pockets when they are distended with pus. One such area is in the floor of the mouth, a second is deep to the submaxillary and the parotid glands, a third is found in the retropharyngeal area and a fourth is seen along the carotid sheath. It is in the carotid sheath that the danger of hemorrhage is important. The vessel most commonly affected is the internal carotid artery. Although it was not proved in the authors' 2 cases that this vessel was the source of the fatal hemorrhage, it was presumed to be.

To avoid the possibility of hemorrhage, the authors feel that all of the infections in the neck should be incised early. The methods usually used for this drainage, as suggested by Mosher and by Beck, are briefly described. Should hemorrhage occur before the infection has been adequately drained, a ligation of the common carotid artery is advisable. If time permits a test of the effect of this ligation as suggested by Matas, may be worth while. This consists in the compression of the common carotid artery for 10 minutes and observation of the patient for any sensations and reactions of cerebral anemia. This is usually worthy of trial, as the first hemorrhage is rarely the fatal one, and some time elapses between the hemorrhages.

The 2 cases reported occurred in children aged 4 and 7½ years. The first child was admitted with a history of hemorrhage but without any evidence of active bleeding. He improved rapidly after transfusion but on the following day suffered a fatal hemorrhage. The second child was admitted with a similar history. A ligation of the external carotid artery was carried out. A ligature was placed around the common carotid artery but not tied. After 4 days the ligature was removed. A few hours later the child suffered a fatal hemorrhage.

WILLIAM C. BECK, M.D.

**Traumatic Lesions of the Larynx.** MEXCE G. LYNN. *Arch. Otolaryng.* 1948, 47: 413.

The traumatic lesions of the larynx, while not frequent, are the cause of a high rate of mortality and

long disability in both military and civilian injuries. The therapy resolves into three stages: the first aid and emergency treatment, the plastic repair stage and the stage of rehabilitation.

In the first stage, the control of hemorrhage, the establishment of a dry airway and the control of shock are the keynotes. In the control of hemorrhage and in the establishment of an airway the author points out two pitfalls. The wound should be debrided only of those structures whose vitality is unquestionably impaired and every effort should be made to preserve as much tissue as possible. The second pitfall is the avoidance of a high tracheotomy. The tracheotomy should be performed as low as possible.

In the stage of the plastic repair a careful analysis of the situation is imperative. The author feels that only by means of direct suspension laryngoscopy is he able to carefully study the structures and plan his procedure. A low tracheotomy should be performed if it has not already been done. Various procedures are described for the re-establishment of a wide patent larynx, as well as those which are indicated in concomitant esophageal injuries and fistulas. Dilatation with tantalum molds is recommended. Loss of part of the thyroid or cricoid cartilages will require grafts from the costal cage.

Rehabilitation, with speech training, is most important. Work of this nature is highly specialized and schools for this purpose have proved their value.

In the discussion, G. E. Martin (Edinburgh, Scotland) and Henry B. Orton (Newark, New Jersey) point out the relationship between the development of carcinoma of the larynx and old traumatic lesions of the larynx, and cite several cases which they have observed.

WILLIAM C. BECK, M.D.

**Laryngeal Tuberculosis. Observations Based on an Experience of 28 Years with Laryngeal Tuberculosis.** EDWARD ANDERSON LOOPER and I. B. LYON. *Ann. Otol. Rhinol.* 1948, 57 754.

Laryngeal tuberculosis is the most common chronic disease of the larynx. In the authors' experience, the occurrence of this complication of pulmonary tuberculosis is decreasing. Among 2,770 patients examined, tuberculous involvement of the larynx was found in 214, or 7.7 per cent of the patients. A survey made by the authors (20 years ago) covering a 5 year period showed an incidence of 15.5 per cent.

The decreased incidence is attributed to improvement in the care of patients with pulmonary acid fast infections. Pulmonary collapse has decreased the chances of infected sputum being brought up and deposited on the laryngeal mucosa to cause contact invasion of the tubercle bacillus. Infected sputum is the most common cause of this illness but organisms may enter by way of the lymph and blood streams.

A thorough examination of the larynx should be made in all cases of tuberculosis as soon as the pulmonary lesion has been diagnosed. Slight congestion, dryness and tickling sensations of the larynx

should receive prompt attention as such symptoms often indicate early invasion of the larynx.

In the authors' experience, cautery of the lesions, combined with general care of the patient and the removal of foci of chronic infection has given the best results. Vocal rest is considered most important and patients were given writing pads for their requests. Cauterization was done under local anesthesia by the indirect method at about monthly intervals.

Elevations of temperature to high degrees, marked asthenia and high blood pressure were contraindications for the use of electrocautery.

The article is accompanied by 5 informative tables summarizing the authors' experience with this illness.

EDMUND R. DOWCORRE, M.D.

#### The Treatment of Laryngeal Papillomas in Childhood. H. ZALUZ. *J. Laryngol.* 64, 6, 6

Papillomatosis of the larynx occurring in infancy and childhood is uncommon. It is observed more frequently in boys between the ages of 18 months and 4 years. It is not familial, although 50 per cent of all cases are congenital. There is evidence that a filterable virus is the causative factor. Papillomas in children are not single and are not confined usually to the vocal cords as in adults, but are multiple, and may occur all over the periglottal zone and recur rapidly following removal, but become quiescent with the onset of puberty.

The presenting symptoms are hoarseness and laryngeal dyspnea, and treatment is difficult and tedious as there is a high mortality from respiratory complications. Treatment is aimed at clearance of the laryngeal thoroughfare with the avoidance of local injury and subsequent dysphonia or laryngeal stenosis. Tracheotomy may be a lifesaving measure.

New and Erich prefer to treat laryngeal papillomas with diathermy. Chevalier Jackson advises avulsion of the tumors by surgical means, to be repeated when necessary. H. feels that radiation injures the larynx unnecessarily.

The fact that gonococcal vaginitis, intractable in children, ceases at puberty, presented an obvious analogy to the problem of childhood papillomatosis of the larynx. Broyles described the treatment of 5 patients at the Johns Hopkins Hospital, Baltimore, with the weekly application of 0.5 cc. of 10,000

units of estrogen per cubic centimeter of oil to the larynx. All 5 cases, 4 of which required previous tracheotomy cleared up within a period of 6 months.

The author describes success in swabbing the laryngeal area with 1 c.c. of dimenformon, 10,000 units per cubic centimeter in oil, once weekly for 5 successive weeks or more in 5 different cases. The results were excellent. The rationale of this treatment is that estrogenic substances will produce a temporarily adult epithelium which is immune to infection in this disease, possibly a filterable virus.

EDMUND D. BLOOMFELT, M.D.

#### Report of Postoperative Course of Subperichondral Total Laryngectomies. EDWARD M. WALLER and EDWIN N. BROYLES. *Ann. Otol. Rhinol.*, 64, 37, 686

The authors' modification of the Crowe-Broyles technique for total laryngectomy for selected cases of cancer of the larynx is described. Their modification varies from the original operation, in that the base of the epiglottis is left attached to the tongue during most of the operation. They believe that this maneuver gives a better view of the pharynx, and the mucous membrane on the dorsal surface of the epiglottis can be utilized later in closing the pharyngeal defect. After the larynx has been removed the mucous membrane on the epiglottis is incised and elevated, and then the epiglottis is removed. The mucous membrane from the posterior cricoid is then sutured to the mucous membrane which was raised from the epiglottis and anchored to the connective tissue in the upper angle of the wound. The remaining defects in the pharynx are closed with inverting sutures.

The authors also report an absence of wound infection in all cases in which the wounds were irrigated with tyrothridin solution at the time of operation. With this and systemic penicillin, they feel there need be no fear of wound infection from the month, as none of their patients so treated became infected.

The periods of hospitalization were relatively short, ranging from 8 to 13 days.

The postoperative course of the last 37 consecutive cases is reported. No deaths occurred in this series.

EDMUND R. DOWCORRE, M.D.

# SURGERY OF THE NERVOUS SYSTEM

## BRAIN AND ITS COVERINGS CRANIAL NERVES

The Surgical Pathology of Brain Abscesses. GEORGE SWINBURNE. *Med J Australia* 1948, 2 169.

The author presents a detailed and complete study of the formation development clinical types regional pathology bacteriology and histopathology of brain abscesses.

The majority of brain abscesses arise from an extension of some inflammatory focus in the ear or nasal accessory sinuses, a smaller percentage follow penetrating injuries to the skull. Metastatic abscesses from another localized abscess or a systemic infection such as endocarditis or furunculosis are less common. Rarer still are abscesses following orbital or buccal infections.

Infection may travel from an external focus outside the skull through the bone and meninges by direct extension or by natural anatomical channels. However it is anatomically impossible for infection to reach the brain by way of the general somatic lymphatic system. Infection by direct extension may result from erosion of the bone followed by necrosis of the dura. The dura itself is resistant to a spreading infection and progress of the infection is delayed temporarily. Usually an extradural abscess forms which produces an inflammatory reaction of the arachnoid and the pia mater and causes their adhesion to the dura sealing the process off. The underlying cortex may undergo an ulcerative process. A subdural abscess may form or a generalized leptomeningitis may occur.

In the case of direct trauma the infection may result from direct implantation in the cerebral tissue from osteomyelitis or from scalp infection.

Infection may penetrate the brain and the blood vessels by the intravascular or perivascular route. Perivascular spread usually occurs after the infection has reached the subarachnoid space. The perivascular infiltration of predominantly mononuclear cells into a sulcus is accompanied by cerebral edema and the formation of numerous new capillaries in the cortex. The cortex itself is invaded by inflammatory cells radiating from the vessels, and by large numbers of endothelial cells and phagocytes. The abscess begins in the relatively avascular zone in the subcortical white matter and tends to spread towards the ventricles. It may be stopped by the central mass of white matter with its relatively good blood supply. Intravascular infection may spread by way of the veins or arteries. In the veins it takes the form of a retrograde thrombophlebitis. After a short period perivasculitis also occurs and the area of the brain normally drained by the thrombosed veins undergoes degeneration first in the relatively avascular subcortical zone in which the abscess later develops. The arterial spread follows the

formation of an infected mural thrombus or a bacterial embolus. In this case the area of cerebral infarction becomes infected.

Nasal or aural infections may spread from the nasal or ear cavities to the subarachnoid spaces along the perineural sheaths around the olfactory auditory or facial nerves. Two vestibular channels may be differentiated the aqueduct of the cochlea and the aqueduct of the vestibule. The latter is probably the commonest route of infection—from the labyrinth to the cerebellum. Erosion of the bony wall of the aqueduct or empyema of the sacculus with spread along the endolymphatic duct may occur. Infection from the mouth through a persistent cranio-pharyngeal canal or from the ear through the hiatus subarcuatus or a persistent petrosquamous suture is of rare occurrence.

In the cerebrum the cortex offers considerable resistance to infection because of its good blood supply. Infection spreads from the relatively avascular subcortical white matter fairly rapidly in a direction parallel with the course of the blood vessels and is caused by tissue destruction which occurs as a result of thrombosis of the vessels around the edge of the abscess. The abscess may drain along its stalk and its pathway of entrance or it may perforate into the ventricles or leak into the subarachnoid space. In the cerebellum extension of the infection occurs in the white matter of one lobule and compresses the surrounding area. Edema and inflammation take place in the more resistant cortex.

Clinically the cerebral and cerebellar abscesses may be classified as adjacent if they occur in the immediate neighborhood of a focus of infection (otogenous rhinogenous osteomyelitic and traumatic) and nonadjacent, or metastatic. The former are usually single and are situated in the frontal or temporal lobes or in the cerebellum the latter often are multiple and occur in the course of an overwhelming generalized septic process or (more commonly) secondary to subacute pulmonary infection or infections of the urinary tract.

Temporal lobe abscesses are secondary to aural infections. The infection spreads from the roof of the attic or mastoid antrum into the middle fossa and the inferior surface of the temporal lobe. Frontal lobe abscesses are secondary to frontal or ethmoid sinus infections. They often grow to a large size with a thick wall before manifesting any symptoms. Abscesses of the parietal and occipital lobes are uncommon and usually of pyemic origin. They may follow a retrograde thrombophlebitis from a thrombosed lateral sinus or a local osteomyelitis. Adjacent abscesses of the cerebellum are usually of aural origin and are found in the posterior inferior or posterior superior lobules.

The cerebrospinal fluid in brain abscesses contains a large number of polymorphonuclear cells during

the period of meningitis, and a greater number of lymphocytes during the period of localized encephalitis and early abscess formation. A chloride content below 700 mgm. per cent indicates generalized leptomeningitis. When this abscess is encapsulated the fluid chloride content is normal. An increase in total protein and globulin, which is always present, is not diagnostic.

Streptococci are the most common organisms found in brain abscesses. Pneumococci, not infrequently mixed with staphylococci are less common. Occasionally *Bacillus proteus coli*, and anaerobic organisms may be found. *Streptococcus viridans* has also been observed. Anaerobic bacteria do not favor the formation of an abscess capsule.

The author also reviews the histopathological evolution of a brain abscess and describes the phases classified by Carmichael, Kernohan, and Adson as (1) focal necrosis and microglia, (2) primary delimitation and fibrosis (3) secondary delimitation and astroglia, and (4) repair and vascularization. These stages merge gradually into each other and have no particular relationship to the chronological and symptomatic progress of the abscess.

The whole problem of cerebral abscess: its prophylaxis, treatment, and cure has been profoundly modified by the introduction of modern methods of chemotherapy. Repeated aspiration of the abscess under chemotherapeutic control, followed by total removal when it has become stabilized seems to be the best method of treatment. The author is also in favor of dealing with temporal lobe abscesses through a separate clean approach and not through the mastoid and ear. However the problem of treatment of brain abscess is not as yet solved completely.

GEORGE FERRIER M.D.

#### SPINAL CORD AND ITS COVERINGS

Cysts of the Sacral Roots. I M TAYLOR *J Am M Ass* 94:3, 38 140

Cysts of the posterior sacral nerve roots seem to constitute another cause of the sciatic syndrome which may be dealt with satisfactorily at operation.

A case report is noted in detail. The history was that of a typical disc syndrome. There was a traumatic incident followed by pain in the right sciatic distribution of the thigh and leg, with distinct periods of remission and exacerbations. There were, in addition, some paresthesias in the affected extremity. Neurological examination suggested motor sensory, and reflex changes consistent with a diagnosis of protruded nucleus pulposus at the lumbosacral joint. Routine x-ray examinations of the spine were normal and myelography was regarded as essential. The only equivocal finding on admission was no pain either on hyperextension or lateral flexion of the spine.

Hemilaminectomy was performed on the right at the lumbosacral joint with no evidence of any pathological finding. A similar result was obtained on exposing the fourth and fifth lumbar interspace. A

re-examination of the lumbosacral space led to the discovery of a piece of epidural fat which bulged upward. Upon tracing this further by removal of 5 cm. of sacrum on the right, a cystic tumor 1 cm. by 2 cm. was exposed on the posterior division of the second sacral nerve root. The lesion did not connect with the subarachnoid space, and was removed by excising a portion of the posterior nerve root. The patient recovered rapidly having only transient darting pains in her right thigh. The only positive neurological finding was the persistent absence of the right ankle jerk.

A group of cases of backache and sciatica exist, for which there is no adequate explanation. Operations for protruded intervertebral discs have been negative in 10 per cent of the cases which presented typical signs and symptoms requiring operation. In 1938, the author found 5 perineural cysts on extradural portions of the posterior sacral or coccygeal nerve roots in the course of dissecting the filum terminale in 30 cases. He believes that failure to explore the sacral region more fully may mean overlooking some of these lesions and may account for some of the negative explorations in the surgical treatment of sciatica. It is felt that myelography would not demonstrate such lesions because the cystic cavity does not communicate with the subarachnoid space, and therefore diagnosis can be made only by exploration. RICHARD C. SCHWIMMER, M.D.

Discussion on Rupture of the Intervertebral Disc in the Cervical Region. W. RUSSELL BRAIN, G. C. KNIGHT and J. W. D. BULL. *Proc. R. Soc. Med. Lond.*, 1948, 4, 309.

W. RUSSELL BRAIN. Although protrusions of the intervertebral disc are common in both the lumbar and cervical regions the comparative anatomy reveals that the disc is relatively larger in the cervical region and contributes more to the lordotic curve. In the cervical region the spinal cord is anchored firmly and the roots run a short course hence, producing greater fixation of the cord and more likelihood of direct pressure. The posterior longitudinal ligament does not reach the lateral margins of the disc and is weakest in the midline. Disc protrusions are likely to occur either in the midline and cause spinal cord compression, or at the lateral margin, producing root compression. This author discusses the possibility of many of the symptoms being produced by pressure upon the veins and arteries with the secondary changes of edema or ischemia.

The discussion is based largely upon 10 surgically verified cases. Eight patients exhibited signs of spinal cord compression while 2 had symptoms only of a radicular type. It is realized that the relative frequency of these two clinical pictures is not represented by the 10 cases. Trauma appeared to be a factor in only 2 of the patients. Osteoarthritis was present on x-ray examination in 7 of the 10 and in 1 patient there were osteoarthritic changes in the thoracic spine only. A traumatic origin was thought to be more likely in the younger patient whose con-

dition was possibly associated with a congenital weakness of the disc. Osteoarthritis was thought to be a very definite etiologic factor in the older age group. The etiology of osteoarthritis as a causative factor is obscure and may be associated with osteophytic changes. In 6 cases the disc protrusions occurred at the fifth cervical interspaces in 2 cases at the fourth cervical interspace and in 1 case each at the second, third and sixth cervical interspace.

The mode of onset may be acute with special involvement of the neck and one upper limb. This usually follows trauma which may often be very slight. An insidious onset, which may be remittent in type, may be associated with symptoms of either radicular or spinal cord compression. The most common radicular symptom is pain which is described as shooting or burning in character and corresponds to the distribution of the nerve root involved. It is usually made worse by coughing or by movements of the neck. The area of pain may be more extensive than the actual distribution of the nerve root. Sensory loss is often slight and rather patchy. Although slight muscular weakness may be present a gross muscular wasting is unusual. Spinal cord compression usually resulted in greater damage to the pyramidal tract than to the sensory pathways. A Brown-Sequard syndrome was found in 4 cases; however the laterality of the disc protrusion could not be made out on the clinical basis alone. Involvement of the posterior column was rare and only 1 patient showed much damage to the spinothalamic tracts.

Examination of the cerebrospinal fluid showed some abnormality in 8 cases which were investigated by this means. This consists of evidence of a subarachnoid block (in 4 cases) or an increase in the protein content of the spinal fluid. X-ray examination revealed osteoarthritic changes in 7 of the 10 cases and myelography yielded positive results in all 6 cases in which this procedure was carried out. Although movements of the neck are somewhat limited, particularly in cases of acute rupture examination may be surprisingly negative in chronic cases with osteoarthritis. The diagnosis can be verified by changes in the cerebrospinal fluid and associated x-ray changes, however in doubtful cases myelography may be necessary. Conservative treatment will often give good results particularly in patients with radicular symptoms; hence an operation would be necessary only in patients with persistent symptoms and with evidence of spinal cord compression.

G. C. KNIGHT. The author agrees with Stookey with regard to the three types of herniated cervical discs—root compression, hemi-cord compression or anterior midline compression of the spinal cord. However he points out that occasionally the symptomatology may be that of a progressive lesion changing from one phase to another. In a comparatively brief discussion he presents an excellent description of the symptomatology of the various types of compression.

Acute protrusions of the cervical disc may occur following comparatively mild injuries. These may be seen in elderly patients after a fall or even on a sudden movement of the neck. If the disc protrusion resulted only in a contusion of the spinal cord then a substantial degree of recovery might be expected. If however the anterior spinal artery is occluded by a disc, then there is great likelihood that the condition will be irrecoverable.

The earliest symptom of nerve irritation is characterized by exacerbations and remissions of severe pain usually in the lower portion of the neck radiating to the shoulder and down the upper extremity in the distribution of the nerve root involved. Protrusions at the fifth or sixth cervical interspaces cause pain in the shoulder, the supraclavicular fossa and lateral aspect of the upper arm, but rarely into the forearm or the hand. If the sixth cervical nerve is compressed the patient will usually complain of paresthesias on the radial side of the forearm and thumb. Irritation of the seventh root will produce paresthesias on the back of the index, middle and ring fingers and on the dorsum of the hand. In some, what larger protrusions, the nerve root may be fixed and compressed resulting in less pain but in more neurologic signs. A more severe compression will result in a greater degree of motor weakness and sensory loss. In rare cases the pain may radiate into the anterior pectoral region and may sometimes be diagnosed as pseudoganglia.

Compression of half of the spinal cord by a protruded disc may result in a typical Brown-Sequard syndrome. In greater degrees of involvement of the spinal cord there are usually signs of damage to the pyramidal and spinothalamic tracts. The signs and symptoms however may be variable and occasionally a diagnosis of subacute combined degeneration may be made.

The treatment will depend upon the type of disc protrusion. In cases of root irritation especially in the early stages, conservative treatment is definitely advocated. Knight treated 29 patients by conservative measures and complete relief was obtained in 24 cases. A partial hemilaminectomy was required in 5 cases. In all cases showing evidence of unilateral cord compression a laminectomy is required. In cases of bilateral cord compression there is some doubt as to the advisability of attempting to remove the disc, especially since attempts to do so may lead to an increase in neurologic signs. In such cases a decompression and section of the dentate ligaments may be all that should be done.

J. W. D. BULL. The author presents a careful qualitative study of the volume of both the lumbar and the cervical intervertebral discs. Considering that 15 per cent of the volume of the disc may be nucleus pulposus, the greatest portion of the nucleus pulposus that could be extruded would have a diameter of 0.7 cm. Usually, of course, they would be much smaller than this amount. It is pointed out that in the lower cervical region the cervical nerves extend out from the spinal canal between two joints.



The anterior joint is formed by a synovial lining between each vertebra. This small anterior joint is usually not mentioned in anatomical studies. Although the author presents diagrams revealing the various types of disc protrusions, particularly the midline posterior protrusion and the lateral protrusion, resulting in nerve root irritation, he appears to be quite skeptical that the actual protrusion would be sufficient to produce the neurologic signs presented by these patients. In verified cases of definite protrusion of the disc, the author feels that there must be some other degenerative or neoplastic process in addition.

The narrowing of the lower cervical interspaces is thought to produce irritation of the anterior synovial joint resulting in a small effusion with thickening of the tissues and compression of the nerve root. These changes may be detected by x ray examinations, especially by oblique views of the cervical spine.

The roentgenographic examination of the patient should consist of anteroposterior, true lateral, and right and left oblique views. The frontal roentgenograms should be taken last in order to determine the direction of the ray since there is often a tilt of the lower three cervical vertebrae.

JACK I. WOOLF, M.D.

**Cordotomy and Leucotomy (Chordotomy and leukotomy)** U. S. A. 1943. *Deut. med. Wochschr.* 94, 73-39.

The relief of intractable pain by cordotomy and by leucotomy is discussed in this article. Special attention is paid to the anatomical and physiological concepts which are involved in both procedures. Routine cordotomy with section of the lateral spinothalamic tract in the cervical region is described in detail and particular emphasis is placed upon the fact that the fibers of the lower extremity tend to be more laterally in the tract than those of the upper extremity and sacral areas. The postoperative changes in various sensory modalities are listed, but no note is made of the complications associated with injury to fibers controlling the bladder or the motor power in the lower extremities.

The theory of leucotomy is reviewed. It is believed that interruption of the thalamocortical fibers eliminates the driving force of the thalamus acting upon the frontal lobe, and that section of corticofugal or frontothalamic fibers removes the rather rigid control which the frontal lobe exerts upon the thalamus. With the interruption of the tangentially lying associated fibers there is a loss of memory of previous painful experiences. The immediate postoperative state is one of stupor, depression and confusion but

the author believes that alleviation of most of these symptoms is to be expected along with little diminution of intelligence. The unfavorable sequelae of the procedure are discussed in more detail than those of cordotomy.

According to the author the problem of relief of intractable pain can be approached from two points of view "the sensory theory" with the associated treatment by cordotomy and "the emotional theory" with its corresponding procedure of leucotomy. Throughout the article the author cites various physiological experiments on animals as the basis for his concepts regarding the underlying principles of these operations.

RICHARD C. SCHNEIDER, M.D.

### PERIPHERAL NERVES

**The Bridging of Large Nerve Defects (Zur Frage der Ueberbrückung grosser Nervendefekte)** B. HORN. *Chirurg.* 94, 19: 253.

The author reviews the process of nerve degeneration and regeneration and discusses various types of nerve repair including the bridging of nerve defects with foreign material and autogenous and homogeneous nerve grafts.

He proposes the bridging of large nerve defects with a cable graft obtained from the phrenic nerve. The advantages of such a graft are numerous. It is an autogenous graft, it is a motor nerve, its length and caliber are greater than that of sensory nerves, and it can be obtained easily by avulsion through a small wound. The unilateral paralysis of the diaphragm does not produce complications or disturbances in the function of a normal lung.

The author presents 2 cases in which he has used a phrenic autograft. In 1 patient he bridged a defect 10 cm. long of the right ulnar nerve with a cable made of 20 cm. of the phrenic nerve. The nerve was repaired 2 years after the injury. Although the patient had a postoperative wound infection the author reports a complete return of function of the flexor pollicis brevis and adductor pollicis muscles and partial return of function of the interossei 6 months after the operation.

In the second case he repaired (11 months after injury) a defect 8 cm. long in the right radial nerve with a cable graft obtained from 15 cm. of phrenic nerve. He drained the wound but there was also a postoperative hematoma. Beginning return of function was observed 34 days after operation, and after 3 months the patient could extend his fingers actively but he was not yet able to dorsiflex his hand.

GEORGE PERRET, M.D.

# SURGERY OF THE THORAX

## CHEST WALL AND BREAST

Reduction of Massive Breast Hypertrophy H O  
BAMES. *Plast. Reconstr Surg* 1948 3 560.

The experience gained in 25 years of mammary plastics resulted in the production of a film in sound and color with the color cinematography intended to be so exact as to leave no doubt about any phase of the surgical technique each step being explained as encountered.

The film was well received but the desire of the author to answer more completely some of the questions asked about the operation inspired the publication of this article.

Massive breast hypertrophy is considered a condition which is frequently encountered and it is believed that the subject has a justified complaint and is entitled to relief and that by radical surgery.

Two well defined procedures are in vogue. One seeks to avoid tissue necrosis by simple amputation enough tissue being left to suggest a reasonably normal sized breast, and upon this mass the separately

amputated areola and nipple are transplanted as a free graft.

The other method maintains the areola and nipple in undisturbed continuity with the glandular portion and at the same time creates a well shaped normal appearing breast.

The author discusses the physiology of the reconstructed breast from the aspect of lactogenesis. Such function exists in minimal degree or not at all in the very large breast, and surgery cannot destroy create, or recreate it.

The disturbance of the endocrine balance is discounted by the fact that these huge hypertrophies are of fibrous tissue and fat which replace normal glandular structure.

The blood supply is discussed and the all important point stressed is that the central core of the remaining breast tissue must be left attached to the chest wall on the broadest possible pedicle of undisturbed circulation. In this connection it is important to avoid trauma in handling the remainder of the blood supply excessive or rough handling or twisting

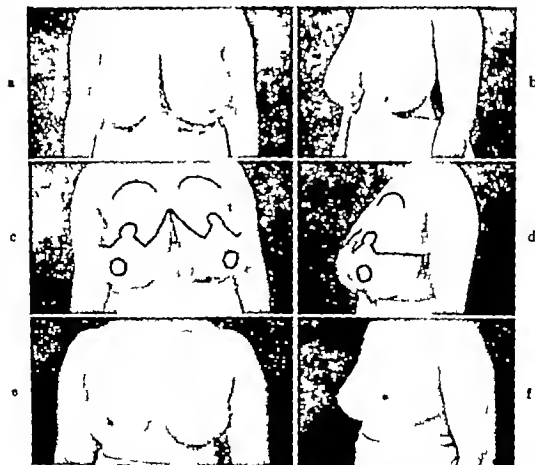


Fig 1. (BAMES) a and b, Front and profile views before operation. c and d, Front and profile views showing markings for incisions. e and f, Front and profile views after operation.

of the tissue may lead to thrombosis which can result in necrosis.

The author contends that mere reduction of size and relief of physical distress are not sufficient, but that the attempt should be made to correct psychological distress by creating a form, shape and position with fullness and firmness of bosom desirable in the female figure. To attain this desirable result, painstaking preoperative study and planning is fundamental.

The operative, planned procedures are outlined in advance. Photographs are made for the record.

Skin markings are made to establish the pattern of the proposed changes, and are checked with the patient in different positions. Modifications of the original design are made at this time if necessary.

The two patterns which must be applied to obtain a satisfactory correction are

The pattern of skin incisions which affect the shape that is to be created only from the skin fixation viewpoint.

The deep pattern for elimination of the excess breast tissue, the realignment of the remainder and its fixation on the chest wall.

The marking fluid preferred is 5 per cent brilliant green in 95 per cent alcohol, and a marker is made of an applicator wound with a small amount of cotton.

The tentative design is sketched in with ordinary green ink. These markings are studied, modified or changed until the design has been found acceptable in all positions when the permanent stain is applied.

Detailed descriptions are given of the development of the designs, illustrated by excellent explanatory drawings.

The operative procedures are discussed in detail, and the dangers inherent in careless technique and operative trauma resulting in interference with the circulation are emphasized.

The author presents the complete technique of a one-stage operation for the reduction of massive breast hypertrophy which has been found most effective and gratifying in 25 years of experience with mammoplasty. **FREDERICK W. MERRIFIELD, M.D.**

31 Malignant Lesions of the Breast. Statistical Review with Results of Therapy (Lesões malignas da mama. Revisão estatística e resultados terapêuticos). **MARIA CLAUDIA MARIA, Arq. Ps., 947 p. 1**

This lengthy article represents a statistical study of breast cancer at the Oncological Institute of Portugal, including the cases seen between January 1939 and December 3, 1942. There were 946 cases in this report, 932 occurred in women and 14 in men.

The data are condensed in table form, giving the age of the patients and the incidence, location, duration, and initial symptoms of the disease. Eighteen of the 932 women noted a discharge from the nipple as the first symptom. Nine patients had bilateral lesions.

Concerning the results of treatment there were 186 patients who had undergone treatment prior to

admission to the Institute and on whom only incomplete data were available. These cases are tabulated separately. The remaining patients, treated exclusively at the Institute, are analyzed according to the method of treatment—irradiation or surgery. These cases are broken down into the clinical groups of Steinfeld and the results are tabulated accordingly. The cases treated surgically are still further broken down according to histologic type.

Three cases of Paget's disease, and the cases in males are analyzed separately. There are 46 major tables of statistics. **HERMAN T. LAWSON, M.D.**

Radical Mastectomy. **HENLEY ATKINS, Brit. J. Surg., 1948, 35: 87**

Since the time of Halsted, radical mastectomy has been the treatment of choice in early carcinoma of the breast. To meet better the standard criteria laid down for an adequately executed radical mastectomy the author describes certain modifications in technique.

The skin is infiltrated with a 1 to 500,000 solution of adrenaline in normal saline, both under the incision and deep to the skin flaps over a wide area, thus rendering the dissection of the flaps nearly bloodless and defining precisely the plane of skin reflection.

The second modification consists essentially in leaving the medial skin flap to the last stage of the operation, dissecting the axilla first and securing the trunks of intercostal vessels as they emerge, thus further controlling hemorrhage. A generous area of skin is usually removed and any raw areas are covered with "postage stamp" split skin grafts. Dead space is obliterated by means of the cotton-wool snowball, and arm movements are encouraged from the second postoperative day onward.

**JAMES E. THOMPSON, M.D.**

## TRACHEA, LUNGS, AND PLEURA

The Syndrome of Bronchial Obstruction with Permeable Stenosis; (Filtration of Air) (El síndrome de la obstrucción bronquial con filtración aérea). **RAUL F. VACCAREZZA y ALBERTO SOUBRIÉ, An. Card. Pul. Clin. Labor., 947 p. 5.**

Bronchial obstruction is generally considered to be of three types:

1. Partial—In which type there is a free passage of air through the stenosis, even though this be reduced in volume.

2. Valvular—In which the arrangement of the stenosis is such that air passes the stenotic area with relative ease in one direction only. The most common occurrence is for the inspiratory rush of air to be freer than the expiratory which leads to progressive distention of the lung distal to the point of obstruction. This condition is called obstructive emphysema.

3. Complete—in which there is no passage of air past the stenosis. The present article concerns itself with an attempt to describe a functional type of

bronchial obstruction which permits the passage of sufficient air to maintain aeration of the lung parenchyma yet does not provide for significant ventilatory function of the lung.

Nine case histories are given as illustrations of this syndrome. They were all cases of pulmonary tuberculosis of rather long standing which presented retraction of the affected hemithorax, cavernous lesions in the upper lung field, retraction of the mediastinum and decreased radiotransparency of the base. They were predominantly unilateral lesions. Bronchial obstruction was not visualized in the majority of cases it being supposed that such obstructions were beyond the range of visibility.

Bronchosprometric studies revealed virtually no ventilatory or respiratory function on the affected side. The occurrence of an aerated lung (as shown by x rays) which however has no ventilatory or respiratory function (as determined by bronchosprometric or oxygen saturation studies on blood) is explained by postulating a type of bronchial obstruction through which air in small amounts only may filter.

HIRAM T. LANGSTON M.D.

**Echinococcal Disease of the Lung. Surgical Treatment** (*Equinococcosis pulmonar Tratamiento quirúrgico*) JORGE A. TALANA, EDUARDO SCHIEPPATI, and RODOLFO BORAGINA. *Rev. As. Méd. Argent.*, 1948 61: 441.

This well illustrated article reviews briefly the surgical management of echinococcal disease of lung indicating the various procedures that have been utilized in the evolutionary history of thoracic surgery. The management proposed includes:

1. General anesthesia (cyclopropane ether given endotracheally with pentothal induction).
2. Wide exposure by thoracotomy preferably posterolateral.
3. Adequate management of small cysts by incision and evacuation of the contained parasite, resection of the pericystic adventitial coat, suture of communicating bronchi and closure of the lung defect. The pleura should be drained.
4. For cysts of large size, multiple cysts or large cysts accompanied by complicating lung disease, resection of the involved lung is the treatment of choice. This is done by individual ligation technique. Whereas segmental resection may be feasible, the authors have preferred total lobectomy or pneumonectomy.

Of 29 cases of pulmonary echinococcal disease treated surgically 9 were managed by resection with entirely satisfactory results and without a fatality.

Numerous roentgenograms, photographs of specimens and 7 concise case histories amply document the article.

HIRAM T. LANGSTON M.D.

**Solitary Pulmonary Abscess Treated by Primary Pulmonary Resection** JENS L. HANSEN. *Acta chir. scand.* 1948, 97: 1.

The treatment of chronic pulmonary abscess by primary resection is advocated because of the tendency

toward the formation of bronchial fistulas and cavities and in an attempt to reduce the long postoperative period following simple pneumonectomy for chronic lung abscess.

Fourteen patients with solitary putrid pulmonary abscesses were submitted to radical operation: pneumonectomy (2), lobectomy (11) and partial lobectomy (1). Two had cavernous tuberculosis with severe putrid infection. In the remaining cases radical operation was indicated because of (1) duration of the disease (2) recurrence (3) bouts of severe pneumonia or hemoptysis or of both and (4) a location which made pneumonectomy impractical (subcapsular supra axillary, interlobar mediastinal).

One patient died in the immediate postoperative course of cor pulmonale. The condition in the 2 tuberculous patients improved considerably for the first several months after operation but death occurred 1 year later. The remaining 11 patients recovered and were able to return to work earlier than would have been possible following pneumonectomy.

Radical operation is considered inadvisable in acute stages of pulmonary abscess.

C. FREDERICK KITTLE, M.D.

**Streptomycin in Surgical Infections. Lung Abscess and Empyema.** EDWIN J. PULASKI and THOMAS T. WHITE. *Ann. Surg.* 1948 128: 313.

Seventeen cases of lung abscess, nontuberculous empyema, and tuberculous empyema were treated with streptomycin. In 2 of 3 cases of lung abscess improvement which could possibly be attributed to streptomycin was noted. Five patients with nontuberculous empyema were benefited by the use of streptomycin. However 1 patient presented no improvement until adequate surgery was combined with the antibiotic. Streptomycin was tested in 9 cases of tuberculous empyema. Three of the 9 patients were treated by medical measures only with no sign of improvement. It is clear that streptomycin is of no value in chronic productive tuberculosis. Bronchopleural fistulas and empyema of tuberculous origin will not show improvement following streptomycin therapy if the parenchymal lesions show no improvement. In 2 of 2 patients treated by closed tube drainage and streptomycin, the condition became worse, while in the other it showed improvement only after penicillin was added to the therapy. Streptomycin was used as an adjunct to extensive surgery in the treatment of 4 patients with definite benefit.

Streptomycin may suppress the pyogenic organisms in a mixed tuberculous empyema and permit the case to be managed as a purely tuberculous empyema. However it may be of advantage to add penicillin to the regimen to secure maximal benefits. Streptomycin appears to afford protection during extensive maneuvers in open mixed tuberculous empyema and is extending the scope of surgery by permitting a direct attack upon the visceral fibroplastic membrane.

JENS E. THOMPSON M.D.

**Bronchial Adenoma.** CARLTON R. SOUTHERS and J. W. KIRKLEY JR. *N. England J. M.* 1948, 39, 459.

This report from the Lahey Clinic in Boston, Massachusetts reviews the experience with bronchial adenoma over a period of 18 years. Of 217 histologically classified primary lung tumors, 15 were adenomas—an incidence of 6.9 per cent.

This tumor is usually accessible to bronchoscopic vision and its characteristic gross appearance in most cases will serve to differentiate it from carcinoma. It is a potentially malignant tumor but the malignancy is of a low grade.

Sixty per cent of these tumors occurred in patients under 40 years of age and a slightly greater percent age occurred in females than in males. Chronic cough, hemoptysis, repeated bouts of pulmonary infection or atelectasis, a localized wheeze or evidence of obstructive emphysema should arouse suspicion of the possible presence of an adenoma.

Since surgical resection eradicates the area of damaged lung as well as the entire tumor it constitutes the treatment of choice in most cases. Eleven patients in this series were so treated. There were no deaths. Local removal may suffice for pedunculated tumors without extrabronchial extensions (which are frequent) or irreparable lung damage but the possibility of recurrence requires continued observation.

The data on the 15 patients are summarized in table form and include age, sex, duration and character of symptoms, physical x-ray and bronchoscopic findings, treatment, essential pathology and follow-up. The latter runs from 5 months to 65 years in 13 of the cases. In 1 case the treatment has been too recent to justify comment and in another the patient has been lost to follow-up.

HIRSH T. LANGSTON, M.D.

**Cytological Diagnosis of Pulmonary Cancer** (Clasificación del diagnóstico del cáncer de pulmón.) GUTIERREZ TERZANO and JOSE MARIA E. MEXIAZOLA. *Dis. del B. Air.* 1948, 20, 68.

The authors present a review of the possibilities of diagnosis of bronchogenic carcinoma by examination of the sputum or bronchial secretion. The technique for fixing and staining the material as well as the general description of the cytological elements of normal secretions and secretions from tumor bearing bronchi are briefly reviewed. The paper is based on a review of the literature and includes a bibliography of 23 references. HIRSH T. LANGSTON, M.D.

## HEART AND PERICARDIUM

**Analysis of Malformations of the Heart Amenable to a Blalock Tausig Operation.** HIRSH T. LANGSTON. *Am. Heart J.* 1948, 35, 3.

The Blalock Tausig operation is designed to increase the circulation to the lungs therefore it is of benefit to patients suffering from lack of adequate pulmonary blood flow provided the heart can adjust itself to the altered circulation.

Patients with the tetralogy of Fallot can adjust to the altered circulation. Other types of malformation improved by operation are those with a cardiac contour similar to that of the tetralogy of Fallot with left axis deviation, those with partial rotation of the heart on its axis, possibly those with pure pulmonary stenosis and an auricular septal defect, and some with unusual arrhythmias. The operative risk, however, is considerably greater in persons who have atypical malformations with pulmonary stenosis or atresia than in those with the tetralogy of Fallot.

The six criteria essential for successful operation are (1) the primary difficulty must be an inadequate pulmonary blood flow (2) there must be a pulmonary artery suitable for the anastomosis (3) a systemic artery must be available for the anastomosis (4) the pressure difference between the systemic and pulmonary circulations must be great enough for the blood to flow from the aorta to the lungs (5) the lung structure must be such that the patient can tolerate collapse of one lung and temporary occlusion of one pulmonary artery and (6) the structure of the heart must be such that it can adjust to the altered circulation.

In an analysis of heart structure it is emphasized that (1) venous blood must be directed to the systemic circulation (2) the increased volume of oxygenated blood returned from the lungs must be able to reach the aorta (3) the structure of the particular heart must allow continuous circulation of blood at an accelerated rate and (4) the structure of the heart must also be such that operation does not cause progressive enlargement.

Less than 5 per cent of the patients have exhibited progressive cardiac enlargement or died of cardiac failure. Thirty per cent have shown no increase in heart size, 30 per cent have shown early increase in heart size with subsequent readjustment, 30 per cent have shown cardiac enlargement during the first 6 postoperative months but no further enlargement thereafter.

The results following use of the subclavian artery for the anastomosis have been as beneficial as when the innominate artery has been used. A patient with the tetralogy of Fallot has a 90 per cent chance of marked and sustained improvement by operation.

JAMES E. THOMPSON, M.D.

**Chronic Constrictive Pericarditis.** VACON MORTENSEN and ERIC WARBURG. *Acta med. scand.* 1948, 153, 203.

After presenting a brief review of the collected material dealing with the syndrome of chronic constrictive pericarditis, the authors give a rather detailed report of their own cases. This comprises 23 cases in all. Twenty-five of these were typical and form the main body of the material discussed. The 8 other cases were considered as probable examples of chronic constrictive pericarditis but the work-up on them was not conclusive. Four of them were found at autopsy but clinical data were lacking to prove physiological cardiac constriction. In 8 others the

diagnosis was not confirmed and the last 2 cases were complicated by a tuberculous empyema so that evaluation of the cardiac status was not accurate.

There were 18 men and 7 women all principally young people. Tuberculosis, trauma and rheumatic fever are discussed as the principal etiologic possibilities but no definite conclusions in this regard were drawn.

The clinical picture is briefly described along with the diagnostic features of various means of examination. Dyspnea, enlarged liver, distended neck veins and ascites were common. A protodiastolic gallop rhythm described as a pericardial click is given real diagnostic value. The roentgenologic, electrocardiographic, and kymographic findings are given. Venous pressure readings as high as 400 cm. of water are recorded.

Twenty of the 25 patients were treated by pericardiectomy. Of this number 11 have died. Two patients were not benefited but 7 had very gratifying results. Surgical treatment is strongly advocated for constrictive pericarditis, particularly in the younger age groups. Pericardial calcification is believed to greatly increase the risk of surgery and caution is advocated in its presence. When tuberculosis is known to be the cause, surgical intervention is undertaken if the process is believed to be in a quiescent state.

Finally cardiac insufficiency in young persons, the cause of which is obscure should call to mind the possibility of a chronic constrictive pericarditis.

HIRAM T. LANGSTON, M.D.

### ESOPHAGUS AND MEDIASTINUM

**The Injection Treatment of Esophageal Varices Due to Manson's Schistosomiasis. Preliminary Report.** CARLOS E. MUÑOZ MACCORMICK. *Laryngoscope*, 1948, 58: 993

Schistosomiasis is a parasitic disease that in its late stages closely resembles the so-called Banti syndrome, and frequently kills by exsanguinating hemorrhages from esophageal varices. The author describes the pathogenesis of schistosomiasis and the life cycle. The ova which are laid in the intestinal wall instigate a colitis. Those that are swept away by the blood accumulate in the portal spaces. After the embryo dies and is absorbed, the remaining shell which is very resistant instigates a fibrosis which after 10 years or longer produces the syndrome of hepatic cirrhosis. Since the fibrosis is mainly portal, it causes blockage, portal hypertension, and splenomegaly. Anastomoses then begin to form. The veins in the submucosa of the esophagus are one form of anastomosis.

Diagnosis is based upon a history of exposure to contaminated waters, progressive enlargement of the spleen and liver with contraction of the latter at a subsequent time, a clinical picture of cirrhosis of the liver, eosinophilia, and the finding of ova in the feces. Some special diagnostic procedures are biopsy of the rectal mucosa, skin testing with cercarial

antigen and liver biopsy. The administration of fusidin which contains 13.5 per cent antimony seems to be the treatment of choice. The treatment of bleeding esophageal varices has been by thermocauterization, electrocoagulation, or cauterization through a gastrostomy opening. From a surgical standpoint, splenectomy, ligation of the coronary vein, portocaval shunt, and lienorenal anastomoses have been used.

The author presents a case of esophageal varices due to schistosomiasis, with recurrent bleeding after splenectomy. The patient was treated by four injections of the esophageal varices with 5 per cent sodium morrhuate. A satisfactory result was obtained. The author states that as far as he knows this is the first case of bleeding varices in schistosomiasis treated by this method. He suggests that splenectomy by relieving over 20 per cent of the load from the portal circulation, followed by injection of the varices may prove to be the treatment of choice in cases in which splenectomy is indicated. Recanalization or the formation of new varices is a complicating factor and presents a problem in the timing of injections.

ROBERT E. FLORES, M.D.

**Spontaneous Rupture of the Esophagus.** THOMAS J. KINSHELLA, RUSSELL W. MOORE, and AMAROSE J. HERTZOG. *J. Thorac. Surg.*, 1948, 17: 613

Spontaneous rupture or perforation of the esophagus is more dramatic and tragic than smaller perforations. The condition is more lethal because it is not suspected and the patient's condition is so poor that surgery is not tolerated. On the other hand, smaller perforations usually present little difficulty because of the antecedent history.

The clinical picture is not generally recognized and the majority of cases reported in the literature (over 50) were not diagnosed before death. There is a rather characteristic history with only slightly variable physical findings. The patient is usually healthy, often addicted to alcohol, and frequently a heavy eater. Following vomiting usually with some blood, there is a sudden excruciating pain, frequently epigastric, which is followed by collapse, shock, dyspnea, and cyanosis. The pain is severe and responds little if at all, to narcotics. The findings are those of a patient in shock, frequently upper abdominal rigidity, pneumothorax or hydropneumothorax, and subcutaneous cervical emphysema. The differential diagnosis includes all upper abdominal and thoracic conditions. Only 25 per cent of cases have been correctly diagnosed before death because of unfamiliarity with the condition. The most frequent misdiagnosis has been ruptured peptic ulcer.

The authors report 5 cases of spontaneous rupture of the esophagus. In 3 the diagnosis was made before death, and in 2 of these the condition did not permit a surgical procedure. One patient was subjected to thoracotomy with suture of the rent in the esophagus with silk. The immediate postoperative course was favorable until the eighth day when death occurred on account of pulmonary embolism.

Following their experience, the authors have devised the following plan for treatment: (1) treat shock (2) decompress the pneumothorax by needle aspiration and follow by intercostal catheter drainage (3) discontinue oral food and fluids (4) administer adequate chemotherapy (5) perform a thoracotomy with cleansing of the tissues and suture of the esophagus when the patient's condition permits and (6) use postoperative suction on the gastric contents for several days and then feed through the nasal tube.

An extensive bibliography is included.

W. HARRISON MERRY, M.D.

**Primary Sarcoma of the Esophagus** (*Sarcome primitif de l'œsophage*) J. HORACIO REBARK and ALFONSO ALBAKERE. *Rev. chir. Par.*, 945, 67, 57.

Primary sarcoma of the esophagus is extremely rare, only 60 cases having been published in the literature up to 1944. The differentiation from carcinoma is nearly always impossible prior to surgery or autopsy. Esophagoscopy does not help in the diagnosis as to the kind of tumor and biopsy should be discouraged in cases in which the mucosa appears intact. Clinically dysphagia seems to be less severe than in carcinoma but more severe than in benign tumors.

The authors describe in great detail the case of a man 56 years old, who complained of dysphagia, retrosternal oppression, and hoarseness due to paresis of the left vocal cord. An extrinsic tumor of the superior third of the esophagus was removed by the cervical route after resection of the sternal portion of the sternocleidomastoid muscle. Histologic examination revealed a primary fibrosarcoma of the esophagus. The patient gained 9 kgm. postoperatively but died 3 months after surgery of metastases in the trachea.

WALTER M. SOLIMTZ, M.D.

#### MISCELLANEOUS

**Strangulated Diaphragmatic Hernia** B. NOLAN O'CARTER and JEROME GIVERRI. *Ann. Surg.* 1948, 28, 3.

In a review of 39 cases from the literature together with 4 cases from the author's own hospital records the clinical picture of strangulated diaphragmatic hernia is presented. Emphasis is placed on the striking consistency of the history and physical findings, as follows: (1) history of a previous thoracic injury, (2) physical findings referable to the left chest, particularly displacement of the heart to the right, dullness or tympany in the lower portion

of the thorax, adventitious sounds, and aspiration of bloody fluid from the left pleural cavity (3) roentgenologic findings suggestive of a high left diaphragm with displacement of the heart to the right and (4) signs of acute gastrointestinal obstruction with particular emphasis on the fact that where the stomach alone is strangulated there is absence of abdominal distention and a patent intestinal tract. The use of a combined thoracoabdominal incision is recommended in the surgical treatment.

BENJAMIN GOLDMAN, M.D.

**Anesthetic Block of the Vagus and Phrenic Nerves and of the Sympathetic Trunk at the Neck in Thoracic Surgery. Its Protective Effect on the Arterial Blood Pressure. Experimental Study.** (II blocco anestetico del vago del simpatico e del frenico al collo in chirurgia toracica. Sua azione protettiva sulla pressione arteriosa. Ricerche sperimentali.) FRANCO SOAVE. *Chirurgia* 1948, 3, 193.

Nine dogs were used in the author's study. A Ludwig manometer connected up to the femoral artery was used to control the blood pressure. Under intra-venous anesthesia and artificial respiration by means of the Palmer apparatus, the pleural cavity on the right side was opened. With a long curved forceps a mild traction, compression or both, as exercised on the pulmonary hilus as a whole and on its constituent structures (bronchus artery vein) separately.

One of the animals died during the manipulations; however the remaining 8 invariably exhibited a drop in blood pressure with the traction or compression as described. The pulmonary vein seemed to react to the manipulations with a greater and longer lasting drop in blood pressure than did the hilus as a whole, the bronchus or the pulmonary artery. This behavior on the part of the pulmonary vein leads the author to believe that he has substantiated the work of Morin and Del Poll (*Arch. Sc. med. Tor.* 1937, 48, 229) on the special sensory receptors in the wall of the pulmonary vein.

After the control tracings were recorded the large nerve trunks in the neck were then blocked in each of these animals with from 10 to 15 c.c. of 0.5 per cent novocain. The tracings were then repeated under the same conditions as before. The nerve block did not entirely prevent the drop in blood pressure; however the drop was unimportant in fact, often imperceptible and leads the author to regard the blocking of the three large nerve trunks in the neck as a valuable therapeutic adjunct in the surgery of the thoracic cavity. JOHN W. BAKERMAN, M.D.

# SURGERY OF THE ABDOMEN

## GASTROINTESTINAL TRACT

Gastroscopic 'Cytodiagnosis' (Über gastrokopische "Zytodiagnostik") HANS STOLLMEIER. *Deut. med. Wochschr.*, 1948, 23: 330.

Fifty-eight patients with gastric disturbances observed by the author at the Ludolf Krehl Medical Clinic of the University of Heidelberg were studied cytodiagnostically. The material for examination was obtained by means of a small alteration (Hartert) at the end of an ordinary flexible gastroscope. The method is without trauma to the mucosa. In the recognition of the eventually present cancer cells the atypical forms and especially the relation between the protoplasm and the nucleus of the individual cells were given the most important place in the diagnosis. Details of the cytologic studies will be given in a separate article by Doerr, the pathologist.

In 28 of these 58 cases there was a certain clinical diagnosis of inflammation (ulcus gastritis) and the cytologic findings corresponded perfectly. In the remaining 30 cases with a clinical diagnosis of carcinoma or the suspicion of carcinoma, the cytodiagnosis gave valuable supplementary aid to the clinical, roentgenologic, and gastroscopic findings in 20 (66%) patients. In several instances in which the clinical examination did not give unequivocal certainty of cancer, the cytologic study furnished evidence of such urgency as to justify operation. In these cases the surgeon was thus brought in contact with a cancerous process which was still at a stage in which resection could be attempted.

The majority of gastrologists have regarded the perfecting of the roentgenologic demonstration of the gastric mucosal pattern as the most promising means of bettering the early diagnosis of gastric carcinoma. Others have turned to gastroscopic photography as the best means of directly inspecting and recording (by repeated photography) the suspicious lesion for comparative purposes. In this sense gastric cytodiagnosis may also be regarded as a direct method of mucosal inspection. The method is particularly adapted to the study of conditions existing in the medial and proximal portions of the stomach and in this regard it may serve as a fortunate supplementation of the roentgenologic methods which are better adapted to the study of the medial and distal regions.

JOHN W. BRENNAN, M.D.

Vagotonic Gastric Colic Stimulating Perforated Gastric Ulcer (Vagotonische gastrische Koliken unter dem Bilde des Ulcus ventriculi perforatum) CARL BLUMENBAAT. *Chirurg.*, 1948, 19: 289.

Proper interpretation of severe colicky pain will require differentiation between organic and functional spasms as well as determination of their special organic relation (gastric, intestinal, biliary pancre-

atic, or renal). Operation for apparently well defined perforated gastric ulcer frequently reveals normal conditions. Pseudoperforation symptoms have been attributed to a neurosis of the solar ganglion due to extension of inflammatory gastric conditions along the lymphatics to the solar plexus. Cases have been described, however, in which no gastritis or other symptoms of inflammation could be demonstrated. Darup has attributed such cases to intestinal and vascular spasms due to a disequilibrium between the vagus and sympathetic system.

In patients with ulcer secondary pancreatitis may give rise to perforation symptoms. In 5 of 39 patients presenting the picture of perforated ulcer of the stomach with peritonitis, diagnosis could not be confirmed, that is in 12.6 per cent of the series. These 5 cases are described in detail and the symptoms are tabulated; they reveal a striking similarity to those observed in perforated gastric or duodenal ulcer.

Two types of cases were distinguished in this group: (1) a type characterized by acute onset, more or less marked bradycardia, no rise in temperature, and an extremely short course (12 to 24 hours); and (2) a type in which symptoms developed over a course of 3 or 4 days followed by sudden severe exacerbation with violent pain and a picture resembling perforation peritonitis. Even in this type, however, there was no typical gastric anamnesis. The temperature was elevated and there was no bradycardia in this group while the duration of symptoms varied from 4 to 6 days.

The picture in the first group would not justify the conclusion that the condition was of gastric or inflammatory origin. In the second group the chief etiologic factor would seem to have been gastroduodenitis without demonstrable pathologic-anatomic gastric lesions. In the former group the condition was probably one of vagotonic gastric colic. Adrenalin and atropin were injected into these patients for diagnostic and therapeutic purposes. Adrenalin was thus probably used for this purpose in cases of this kind for the first time.

Acute nonmechanical gastric dilatation has also been interpreted as a pathologic-sympathetic control of the stomach or sympathetic stigma. The same holds true for acute gastric dilatation following contusion of the abdomen. Whether these vagotonic gastric colics simulating perforated ulcer are caused by central peripheral or intramural influences on the parasympathetic system cannot be definitely determined. Probably some local organic sensitivity of the receptive apparatus of the vagus nerve is involved. Bradycardia is a known symptom of vagotonia.

Differential diagnosis must include, besides exclusion of the various organic colics mentioned, elimination of tabes and thyrotoxicosis. Adrenalin and



pilocarpin may be of value in excluding tabes, since their administration in tabes will release fresh attacks. In the gastric crises of thyrotoxicosis the uncontrollable vomiting is a distinguishing feature. In order to exclude perforated ulcer in these cases with bradycardia, but without fever or other signs pointing definitely to perforation the surgeon should await the results of the atropin and adrenal tests. If the symptoms then subside within 0.5 or 1.0 hour further postponement of the operation is justified at least for 4 to 6 hours after the onset of symptoms. In some cases an exploratory laparotomy will be imperative in order to exclude perforation. If the symptoms subside following the administration of these drugs atropin should be given in fair-sized doses for a period of several days in the vagotonic cases and appropriate conservative therapy should be administered in the gastritic cases.

EDITH SCHWARTZ MOORE.

Gastrojejunal Ulcer: Clinical Features and Late Results. JAMES T. PRINGLE and ROBERT H. GIBSON. *Arch. Surg.* 1943, 56, 65

In order to have a basis for comparison of the relative value of partial gastrectomy and vagotomy in the management of jejunal ulcer it appeared worth while to review the results that were obtained in the treatment of jejunal ulcer prior to the use of vagotomy. By this means one can derive some opinion regarding how effective vagotomy must be in order to supplant partial gastrectomy. Data on 83 patients with jejunal ulcer who were operated on in the Mayo Clinic from 1937 to 1942 have been reviewed and as many of the patients as possible have been followed up to determine the late result.

The cause of jejunal ulcer is similar to that of duodenal ulcer. The routine use of gastroenterostomy in the treatment of duodenal ulcer is followed by a relatively high incidence of jejunal ulcer. Similar use of moderately high gastric resection with complete removal of the pyloric antrum is followed by a low incidence of jejunal ulcer. The ultimate frequency of jejunal ulcer after vagotomy and gastroenterostomy remains to be determined. Prevention is of paramount importance in any consideration of jejunal ulcer. Diagnosis of this lesion usually is not difficult. The complications are hemorrhage, perforation, and gastrojejuno-colic fistula.

Treatment of jejunal ulcer is primarily surgical. To date the best results have been obtained by disconnection of the gastroenteric antrum, excision of the jejunal ulcer, and adequate gastric resection of the posterior Polya type. With this type of treatment results are satisfactory over a period of from 5 to 10 years in approximately 85 per cent of the patients who have undergone previous gastroenterostomy. Results are less satisfactory if the original operation is partial gastrectomy. From a physiologic point of view vagotomy would seem to be a sound procedure if the original operation is partial gastrectomy. Late results of vagotomy in the treatment of jejunal ulcer remain to be determined. Of 44 cases

in which this procedure was performed, the immediate results have been good in 19 of 24 cases in which vagotomy was performed for jejunal ulcer that developed after partial gastrectomy, and in 19 of 20 cases in which jejunal ulcer developed after gastroenterostomy.

The Surgical Treatment of Peptic Ulcer. GROSS, CURT, JR. *Surg. Clin. N. America*, 1943, 28, 1193.

The treatment of gastric ulcer is primarily a surgical problem involving excision of a potential cancer, whereas the treatment of duodenal ulcer is essentially a medical problem and operation is required only when the symptoms are rendered intractable by complications.

In the treatment of gastric ulcer gastric resection is the treatment of choice. Since there is almost no tendency for marginal ulcers to develop after operations for gastric ulcer there is no need to perform a vagotomy unless the values of free acid are unusually high. When the ulcer is located so high that it can not be resected without removing all of the stomach, satisfactory results can be obtained by vagotomy provided a biopsy is made to rule out malignancy. Small gastric ulcers can be treated by excision of the ulcer with vagotomy and gastroenterostomy. Vagotomy alone of a gastric ulcer without resection, excision, or biopsy should not be employed because of the danger that carcinoma might be present.

The surgical treatment of duodenal ulcer is still controversial. Some still believe that radical gastric resection is the treatment of choice whereas others prefer the more conservative procedure of vagotomy combined with pyloroplasty or gastroenterostomy.

About 85 per cent of the patients with duodenal ulcer seen at the Cleveland Clinic made satisfactory progress on medical management. In the surgical management, the author prefers transabdominal vagotomy coupled with a conservative operation to afford drainage of the denervated stomach. This preference is based on an experience of but 2 1/2 years but justification for this form of treatment is the result of "superior results" to those obtained by any other method of treatment. Two hundred and twenty-eight transabdominal vagotomy operations have been performed at this Clinic with 4 deaths, a mortality rate of 2.3 per cent. This is slightly less than the mortality rate for gastric resection at the same Clinic in the past 20 years (2.8 per cent).

In the treatment of jejunal ulcer the author prefers transabdominal vagotomy if no obstruction is demonstrable in the roentgenogram. If obstruction is present, a vagotomy is performed, the old gastroenterostomy taken down, and a new one made. The results in 17 patients who were treated in this manner have been excellent and there has been no recurrence of symptoms. These patients have been followed from 1 month to 28 months after operation.

The technique of vagotomy and gastroenterostomy is reviewed as well as that of pyloroplasty.

The author believes that the transabdominal vagotomy coupled with pyloroplasty or gastroenter

ostomy is (a) safer than gastric resection, (b) more effective than gastric resection in controlling the tendency to recurrent ulceration and (c) attended by lesser morbidity and disability than is gastric resection.

HAROLD LAUFMAN M.D.

The Surgical Treatment of Ulcer (Chirurgische Ulkusbehandlung) A. PLEMK and A. ZECKMANN  
Wien med Wschr 1948 98 238.

One hundred thirty-eight cases of stomach ulcer were diagnosed clinically and roentgenologically. However in 24 of these it was proved that the diagnosis was incorrect. Four patients did not have a callous ulcer they were treated by pyloromyotomy 15 per cent of the patients had carcinoma which was recognizable macroscopically and these were subjected to resection. The remainder of the patients had callous ulcer which failed to respond to medical treatment, 56 were subjected to the Billroth I operation 57 to the Billroth II operation and one was subjected to the Madlener operation. The mortality was zero and today at the Allgemeinen Oeffentlichen Krankenhaus in Linz Austria, gastric ulcer is treated surgically with the exception of only a few cases (patients under 40 with serious complicating disease, or with permanent cure after one period of internal management).

Vagotomy is not done in ulcers of the cardia in which internal management is not successful carcinoma is suspected and a Madlener resection is done. In 200 of these the Billroth II operation was done and in 15 resection by exclusion of the duodenum was done. The latter method has been pretty well abandoned with credit to Finsterer. One patient died on the sixth postoperative day of cardiac insufficiency. Vagotomy was added in only 18 per cent of the cases. This procedure did not lower the mortality the author fears disturbance of the motility of the stomach with this operation.

There were 35 patients with gastric ulcer combined with duodenal ulcer. One of these patients was operated upon by the Billroth I operation 30 were operated upon by the Billroth II operation and 14 patients were subjected to resection with exclusion of the duodenum. The total mortality was 5.7 per cent (2 patients). In these 2 patients the ulcer had involved the esophagus.

The author's material for jejunal peptic ulcer comprised 13 patients. Five of the ulcers followed retrocolic gastroenterostomy 4 followed antecolic gastroenterostomy with a Braun anastomosis 1 followed pyloric exclusion 1 an antecolic Billroth II operation with a Braun anastomosis and 1 a retrocolic Billroth II operation with a Braun anastomosis. Eleven of the patients with jejunal ulcers were subjected to a Billroth II operation and 1 was subjected to resection with exclusion. In this group of 12 patients there was 1 death from bilateral pneumonia 3 days after operation. The results of resection with retrocolic gastrojejunostomy in the jejunal ulcer cases especially those developing after antecolic

gastroenterostomy with Braun anastomosis are regarded so favorable that this procedure will be continued. The author is inclined to regard the jejunal ulcer following the two-thirds resection with retrocolic anastomosis as "surgically incurable" and believes that vagotomy with or without subsequent resection is justified in these cases.

Of the 18 patients with massive hemorrhages 2 were treated conservatively and both died the remaining 16 were subjected to resection and 1 of these died. In these cases mistaken diagnoses of esophageal varices will occur. When the hemorrhage did not seem to threaten life it was managed expectantly always with good results. However success in these cases was ascribed to careful selection of the cases for such treatment rather than to the hemostatic treatment instituted. In these cases Meulengracht's diet was not started until 3 to 5 days following the hemorrhage.

Not to be included in this group of conservatively managed patients are those with a history of previous hemorrhages but without anemia or with only a moderate degree of anemia when they come to operation. In these the indication for operation is practically without restriction. However the authors' faith in this absolute rule has been shaken by a recent experience. The patient was 50 years old with hypertension and a long history of ulcer hemorrhages. At the time of admission however the hemoglobin was 95 and the erythrocyte count 4,980. Two internists did not place any contraindications to the resection and the patient had every sign of that type of bleeding ulcer which Allen and Bennett and Thompson declare to be an absolute indication for early operation nevertheless 14 days after the operation the patient developed bronchopneumonia and died.

There were 67 patients with perforated ulcer of which 2 had a jejunal peptic ulcer. Of these 14 were subjected to resection and 53 to invagination and suture. All the resections were done in cases of duodenal ulcer. In 12 of the 52 patients in whom only closure by suture was done gastric ulcer was present and in 39 duodenal ulcer. There were 2 cases of jejunal ulcers in this group. There were three deaths among the total of 67 patients (4.3 per cent). Suture is regarded as the normal method of managing these cases of perforated ulcer when possible with brief history of illness. However these patients subjected to suture are re-examined every 3 months and when possible the resection is put off until later. Primary resection is carried out when the condition is exceptionally opportune for resection when the suture technique is impracticable (e.g., in a niche of a gastric ulcer) and when resection is practicable. The authors do not favor the recently recommended method of treating the freshly perforated ulcer conservatively (gastric drainage with conservative treatment of peritonitis) as the method is too dangerous because of the difficulty of choosing the patients for such treatment.

JOHN W. BRENNAN M.D.

Gastric Polyadenoma (1 polliadenom gastrici) *Ann. nro Bril. Chirurgia*, 1948, 3, 63.

The author presents 2 case reports of polyadenoma occurring in women, one of them aged 60 years and the other 73. Gastric resection was resorted to in both cases with uneventful recovery.

The history and physical findings are not characteristic and the diagnosis is usually made by means of x rays. The use of the gastroscope permits a more accurate diagnosis. The symptoms are usually of two main types: those caused by pyloric stenosis and those caused by invagination into the duodenum. The complications are ulceration or malignant degeneration. Some authors report that from 50 to 60 per cent of the tumors become malignant. If there is one tumor or a few closely placed tumors, local excision may be used. However if the adenoma is sessile or there are multiple tumors present, wide excision is advised. *IOSEAN J. FLEISCHER, M.D.*

Esophagojejunostomy and Esophagogastrostomy in Inoperable Carcinoma of the Esophagus and Gastric Cardia (Oesophagojejunostomie a oesophagogastronomie u neoperovatelných nádorů jícnu a srdce) *VLADIMÍR RAJANT and JAK KOTERA, Leti listy*, 1948, 3, 507.

Twenty four patients with carcinoma of the cardiac portion of the stomach and of the lower two-thirds of the esophagus were treated surgically at the surgical section of the Palacky University in Olomouc, Czechoslovakia, during the period from August 1, 1946 to May 1, 1948. Of these 13 patients were operated upon by radical resection of the tumor and 5 died. Of the 3 with carcinoma of the intrathoracic portion of the esophagus, 2 died of the 10 with carcinoma of the cardia (in 6 of these the intra-abdominal portion of the esophagus was also involved) 3 (30%) died. Of the remaining patients 3 came to operation. Of these 2 were operated upon palliatively with use of the esophagojejunostomy as recommended by Allison (*Thorax* 1946, 239) there was 1 death. This patient died of cardiac syncope. The operation revealed a huge carcinoma of the gastric cardia penetrating into the esophagus and diaphragm, with secondary growths in the liver. The authors raise the question as to whether even this palliative procedure is indicated in the presence of ascites. In the remaining esophagojejunostomy on the other hand the difficulty in swallowing was removed, the patient feels well, has gained weight, and is free of the troublesome nocturnal regurgitation.

F. J. Allaines and Ch. Dubost (*Ann. Acad. Chir.* 1948, 7415-6, 151) have been doing an esophagogastrostomy as the palliative procedure of choice and seem to want to reduce the operation to the status of an exceptional procedure. The authors do not sympathize with this attitude; they believe that such an attitude would be a step backward in surgical progress and that the newer surgical procedures demand a revision of the surgeon's attitude towards operability in these cases. However they do think that even the palliative operation is contraindicated

in the presence of constant pain in the interscapular region, palpable metastases in the lesser peritoneal sack (severely advanced cachexia, ascites (interference with the blood current in the vena cava), metastases in the suprascapular fossa, paralysis of the nerves recurrentes, and invasion of the bronchi by the malignant process. *JOHN W. BRIDGMAN, M.D.*

A Combined Abdominothoracic Incision Particularly Adapted for Use in Total Gastrectomy and Esophagogastrostomy *ANNALS J. KERNOT, Surgery* 1948, 24, 605.

The author presents a detailed description of his technique for an abdominothoracic approach adaptable for use in total gastrectomy and esophagogastrostomy as well as in the repair of large paraesophageal hernias. Although several similar incisions have been described previously—notably those of Marwedel in 1903, Kirschner in 1920, Ohsawa in 1933, Humphreys in 1946, Garlock in 1946, Harper in 1947 and Carter in 1947—none of these incisions provide principally for an abdominal dissection with the idea of extending the horizon of total gastrectomy to include removal of additional segments of the lower esophagus.

The patient is placed in a supine position on the operating table with a sandbag under the left side, which produces about a 10 degree elevation from the horizontal. A kidney brace is fastened on the right side of the table to hold the patient in position when the table is rotated later in the operation. The skin incision begins near the lateral edge of the right rectus muscle slightly above the umbilicus and extends horizontally and upward to the left costal margin where the eighth costal cartilage crosses the seventh interspace. The incision is carried through the abdominal wall into the peritoneal cavity. Abdominal exploration is carried out at this time and operability of the lesion is determined. If a decision to proceed with resection is made at this point, the operating table is rotated elevating further the left side of the patient to 30 to 35 degrees from the horizontal. The eighth costal cartilage is cut and the incision is extended into the pleural cavity through the seventh interspace as far as the midaxillary or posterior axillary line. If total gastrectomy alone with infradiaphragmatic esophagojejunostomy is to be performed, incision of the diaphragm about half way from the costal margin to the esophageal hiatus is carried out. If an additional segment of the esophagus is to be resected, the diaphragmatic incision is continued to the esophageal hiatus. The left phrenic nerve as it passes along the lateral surface of the pericardium, is crushed early in the operation. This reduces the motion of the diaphragm and aids in its subsequent repair and healing.

Dissection of the stomach particularly around the cardia and high along the lesser curvature in the area of the left gastric artery is markedly facilitated by removing the barrier of the costal margin. The abdominal portion of the operation (dissection of the lower stomach, transection of the duodenum, and

duodenal closure are readily accomplished. Mobilization of a jejunal loop for esophageal anastomosis is facilitated and if necessary one can readily section one or more of the mesenteric vessels near their origin to gain added mobility of the jejunal loop as recommended by Sweet. All portions of the operation are performed without limitation of exposure. Because of the added exposure, a wider and more complete excision of lymphatic bearing tissue can be accomplished. Although the incision opens two serous cavities it is believed that the added exposure gained allows for a more careful dissection, preparation and anastomosis so that leakage and infection which has been the principal cause of a fatal outcome in most reported cases are less likely to result. Resection of an added segment of esophagus in doing a total gastrectomy is readily accomplished with the exposure obtained whereas in doing a transabdominal total gastrectomy one cannot with ease sacrifice more than small segments.

Closure of the intercostal incision is as follows:

The diaphragm is circumferentially sutured to the anastomotic jejunal loop to prevent any herniation of abdominal viscera into the thoracic cavity. The last few anterior sutures in the diaphragm are placed from the peritoneal surface and tied later from below after the intercostal incision has been closed. In two areas the rib above and below the incision is bared of periosteum and perichondral sutures of No. 0 chromic catgut are passed around the ribs care being taken to avoid catching the intercostal nerves. Tying of these sutures closes the intercostal space. Further closure is obtained by interrupted No. 000 or No. 0000 silk sutures uniting the cut intercostal muscle bundles. Closure is reinforced by suturing the serratus anterior muscle.

The abdominal component of the incision is closed in the usual fashion with interrupted No. 000 silk in the peritoneal layer and in the anterior rectus sheath. Because of the length of the incision the closure takes considerable time. The time can be shortened by having two closure teams working from either end toward the center.

Two potential disadvantages are pointed out by the author. First unless the patient is rotated somewhat laterally there is a tendency for the heart to interfere with exposure in making a high esophago-jejunal anastomosis above the diaphragm. Second with this exposure one is limited to dissection of the esophagus below the hilus of the lung and the inferior pulmonary vein. An anastomosis must therefore be done below the hilus. Consequently, the incision is not useful in lesions of the midesophagus or above the diaphragm.

HAROLD LAUFMAN M.D.

**End-to-End Anastomoses after Gastrectomy Technique of Suture Following Hemisection (Anastomoses termino-terminales après gastrectomie; procédé de suture après hémisection)** J. HUGUET and C. L. CHATELAIN *Rev. chir.,* Par. 1948, 67, 211

The authors' technique of subtotal and total gastrectomy with end-to-end anastomosis is given

End-to-end anastomosis seems to be the procedure of choice after gastrectomy because it allows a more extensive resection thus eliminating the possibility of marginal ulcer and because it is a more physiological procedure re-establishing the normal continuity of the digestive tract. However this procedure is not without contraindications. It should not be used first in the presence of deperitonealized duodenum, second, in cancer of the fundus requiring extirpation of the retropyloric lymph nodes and third when mobilization of the duodenum is insufficient. The procedure is indicated in (1) benign gastric or pyloric ulcer, (2) perforated ulcers, if the condition of the patient justifies gastrectomy and (3) bleeding ulcer. Moreover the authors advocate its use after total gastrectomy for carcinoma of the cardia and advise an esophagoduodenal anastomosis.

GERARD GAONON M.D.

**Intussusception in Children. Diagnosis and Therapy with Barium Enema** HANS HELLMER, *Acta radiol.* Stockh., 1948, Supp. 65

In an extensive treatise including diagrams and roentgenograms the author describes the picture of intussusception in children, and the technique and results of reduction by barium enema under continuous roentgenologic control. The study is based on 162 cases of intussusception occurring in 137 patients who were diagnosed by means of roentgenograms at the University of Lund, Sweden, during the past 14 years. Forty per cent of the patients were less than 1 year of age.

As a preliminary to reduction plain roentgenograms were taken in the upright and supine positions primarily to exclude other pathologic states—some times located above the diaphragm. The combined diagnostic-therapeutic enema is given by introducing barium through a soft rubber rectal catheter under hydrostatic pressure which is controlled by elevation of the barium reservoir. Fluoroscopic and roentgenologic observation is maintained during the entire time. The importance of the assistant *ad anum* in tightly compressing the buttocks to prevent leakage along the catheter is stressed. Also it is essential that an adequate supply of contrast medium is available at every stage of the procedure. Hellmer uses a 10 liter enema container which is fitted with a thermostat and a stirring device. During the diagnostic portion of the procedure the hydrostatic pressure is kept low (from 50 to 60 cm.) in order that short intussusceptions will not be inadvertently reduced before they can be studied. When the invagination has been located and studied the pressure is increased ordinarily a pressure higher than 1.5 meters is not used. Hydrostatic pressure alone is used chiefly for the reduction and taxis is avoided unless it is required in forcing the intussusceptum back through the ileocecal valve.

No anesthesia whatsoever is used.

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No anesthesia whatsoever is used.

As a criterion of successful reduction it is necessary that the entire colon and cecum be completely filled with the contrast medium. When the reduction

is complete the barium will pass unhindered to a point fairly high in the small intestine.

Reduction with a barium enema was successful in 130 of the total 162 cases (80.3%). In these 130 cases the point of origin of the intussusception was found to be in the small intestine in 60 cases and in the colon in 9 cases. It could not be definitely ascertained in 61 cases. In 30 cases the reduction had to be completed by surgical intervention and among these cases 9 deaths occurred. In 8 cases in which reduction by means of a barium enema failed spontaneous reduction occurred. There were no deaths in the cases reduced by the barium enema alone. There was a recurrence rate of 16.5 per cent among the cases reduced by enema, which is somewhat higher than the recurrence rate following surgical treatment. WATKES FIELD CAMEROX, M.D.

**A Case of Anthrax Intestinalis (Stitch) or Anthrax Intestinalis.** R. STORCKOV, *Chirurgische Societät*, 948, No. 2-3 1937.

A 17 year old girl suffered chills, fever, and generalized abdominal pains following a meal. The attack lasted until 8 o'clock in the evening when the fever dropped and the patient slept the whole night. The next day there were 3 similar attacks of chills and pain which became steadily worse. Nose bleed lasted the whole day and she vomited all of the food she had eaten. During the following 3 days the condition became worse and there were 8 more attacks of chills convulsions occurred and the mind became clouded. On entrance to the hospital a diagnosis of ruptured appendix was made and the patient was operated upon as an emergency.

Upon opening of the abdomen there issued from the peritoneal cavity considerable hemorrhagic exudate. The appendix was removed although it was not obviously pathological and as the patient suddenly changed for the worse the abdomen was hurriedly closed. She died some time later.

Autopsy disclosed a discolored portion of the small intestine, from 10 to 12 cm. in length, immediately above the ileocecal valve, as well as portions of the large intestine covered with a dark colored exudate. The mesenteric and retroperitoneal lymph glands were enlarged. On section the wall of the affected portion of the intestine was found to be edematous throughout with a diameter of from 3 to 3.5 cm. Involving the mucosa was a carbunclelike discolored mass. In the mucosa of the stomach, also, immediately below the cardia, was a carbunclelike lesion, clearly delimited, of irregular form and irregularly necrotic, which protruded into the gastric lumen. In both carbuncles were great quantities of anthrax bacilli.

The author recalls a similar case in 1940 in which anthrax bacilli were found in the spinal fluid sediment, but were at that time considered to be a contamination.

Although the diagnosis during life of intestinal anthrax is exceedingly difficult, nevertheless in all cases presenting a severe abdominal septic picture

the possibility must be considered and the anthrax bacillus should be sought in the blood, spinal fluid, and feces. Once the bacillus is demonstrated, which should not be too hard to do, treatment should be initiated immediately with large doses (300 to 500 cm.) of antitetanic serum, given intramuscularly or intravenously for 2 or 3 days (Andreev).

Recently penicillin has been highly recommended for anthrax infection but even this type of treatment must be started early.

JOHN W. BERNHARD, M.D.

**Duodenal Ulcer—A Follow Up Study of 243 Veterans Discharged Because of Ulcer.** ALLEN E. HUSAR, *Gastroenterology* 948, 1:183.

Duodenal ulcer among military personnel was a much discussed problem in the medical literature during World War II because of its incidence and the difficulties encountered in establishing the diagnosis and in finding the proper policy for the disposition of the soldiers. Because veterans are receiving disability compensation if their ulcer was initiated or aggravated by military service, a postwar problem arose. What is the fate of duodenal ulcer in patients who are being compensated for their illness? Three hundred and five veterans were interviewed and re-examined in order to adjust their compensation received from the government according to the status of their ulcer and the degree of disability. The average length of time elapsed since their separation from military service was 34 months. Only 5 patients had undergone surgery. 300 had medical management.

X ray examination revealed ulcer crater in 22 per cent, irritable bulb in 11 per cent, deformed bulb in 41 per cent, and negative findings in 26 per cent of the cases. Clinical activity as determined from the patient's symptoms was found in 60 per cent. From x ray examination and symptoms, the ulcer was diagnosed as active in 63 per cent and inactive in 37 per cent of the cases. From the patients' histories it was learned that since their separation from service 6 per cent had no recurrences, 9 per cent had no symptoms so long as they adhered to the diet, 11 per cent had rare recurrences, 30 per cent had frequent recurrences, and 43 per cent had almost continuous symptoms. Thirty-eight per cent of the patients who had followed an adequate or fairly adequate ulcer regimen had frequent recurrences or continuous symptoms and were therefore classified as intractable to medical management. The figures obtained from both sources case histories and x-ray findings, were higher than could be expected from noncompensation experience.

The unusual figures were explained by the presence of the compensation factor which caused the patients to exaggerate their symptoms and interfered, through a psychosomatic way with the healing of the ulcer. Evidences of improper ulcer management existed. There were also good reasons to believe that these patients had more emotional conflicts than noncompensation patients. Suggestions

were made to eliminate the compensation factor to educate the patients, and to make psychotherapy available to them.

BENJAMIN GOLDMAN M.D.

Use of the Defunctionalized Loop of Jejunum in Biliary and Pancreatic Surgery L. W. PETERSON and WARREN H. COLE. *Arch. Surg.* 1943, 56: 445

The authors present both roentgenographic and clinical evidence of reflux of the jejunal contents into the biliary tract following anastomosis of a jejunal loop to the hilar bile ducts for stricture and absence of the common bile duct. Reflux occurred even though enteroanastomosis between the ascending and descending loops of jejunum had been performed. In 3 patients subsequent severing and turning in of the ends of the proximal or ascending limb of jejunum resulted in immediate cessation of chills and fever and an asymptomatic course thereafter. This observation led the authors to adopt the principle of the jejunal loop leading to an anastomosis between a cyst and the gall bladder even though an anastomosis was made between the two arms of the jejunum. At no time has roentgen examination showed reflux of barium up the proximal limb of jejunum past such folds or valves through the stoma connecting the intestine with cysts.

Animal experiments showed that the flap type of valves atrophied to such an extent that the valve function would appear impossible. On the other hand valves made by infolding the jejunal wall showed no evidence of atrophy or other significant change for at least 8 months.

The authors found that use of the Roux Y principle in anastomosing the jejunum to the common duct for strictures of the common duct or resection of the head of the pancreas was satisfactory. Originally they constructed valves or folds in the jejunal limb but no longer do so because reflux of food or secretion would have to take place against the peristaltic mechanism. They recommend that the arm of the jejunum above the 1 enterostomy be at least 16 inches (41 cm.) long.

When cholecystenterostomy is performed for inoperable carcinoma of the pancreas they do not modify or lengthen the operation by the construction of folds or valves since the patient will probably die before symptoms of suppurative cholangitis develop. However, when the small intestine is anastomosed to the gall bladder or other structures for benign lesions they recommend construction of two or three folds in the proximal arm of the jejunum even with an enterostomy.

JOHN L. LINDQUIST M.D.

Ectopic Appendix (Appendice ectopica) A. R. ALBARRAZ and S. CROVATY ACUTER. *Chirurgia* 1943, 1: 235

The authors report 2 cases of ectopic appendix vermiformis. In the first the entire large bowel was isolated left of the abdominal midline. Unable to find the colon or appendix through a McBurney's in-

cision, closure was performed and roentgen studies revealed the position of the bowel. At a second operation the appendix was delivered through a left iliac incision and removed. Recovery was without incident.

In the second case, 2 years later when neither the cecum nor omentum was found in their normal position through a McBurney's incision, a dressing forceps inserted into the left iliac fossa produced the omentum and a second forceps delivered the cecum with the appendix. The latter was removed. The patient's recovery was uneventful.

The location of the appendix depends upon the partial or complete rotation of the bowel, which presents the following possibilities: (1) normal, in right iliac fossa (2) oblique colon, with partial rotation of the bowel the appendix lies high under the liver in the superior right quadrant of the abdomen (3) in right hemiabdomen and the entire colon in the left iliac fossa (4) situs inversus, in which there is transposition of all the organs of the abdomen the sigmoid will be in the right and the appendix in the left iliac fossa. This condition the authors believe should be designated complete appendicular ectopia. When the appendix and cecum alone are displaced the term mesoappendicular ectopia should be employed.

STEPHEN A. ZIEGLER M.D.

Volvulus of the Transverse Colon (Le volvulus du colon transverse) CL. OLIVIER and H. LEBAUDE. *Presse med.*, 1943 56: 541

The authors discuss the problem of volvulus of the transverse colon and state that only 16 case reports appear in the literature.

Volvulus of the transverse colon occurs almost always in females past 50 years of age who have had a long history of chronic constipation. The presence of a megacolon can often be demonstrated. The abdominal pain is usually colicky in nature, sometimes similar to that experienced in the passage of a urinary calculus. Even though the obstruction from the volvulus is almost complete vomiting is a late sign and the general well being of the patient is preserved for quite a long period.

The evolution of the illness is slow. Most of the patients whose cases are reported in the literature were operated upon not less than 3 days after the onset of symptoms. The abdominal distention which is predominantly periumbilical is asymmetric in that it crosses the midline on an oblique axis from one or the other hypochondrium to the opposite iliac fossa. The roentgen study of the colon by barium enema usually shows complete arrest of the barium column at the most distal portion of the volvulus.

Volvulus of the transverse colon frequently is caused or accompanied by other local lesions such as polyps or adenomas of various sorts or inflammatory conditions of the immediate area. Early recognition and operative correction of the condition involved is mandatory in order to reduce the significant mortality of the disease.

ORVILLE F. GRIMES M.D.



**The Response to Vagotomy in Idiopathic Ulcerative Colitis and Regional Enteritis.** CLARENCE DIXON, FRANK D. EDDY, HOWARD H. FRYCKMAN, AUGUST M. MCCARTHY and DARRELL WESTOVER. *Ann Surg* 948, 128, 470.

A study of the experience with idiopathic ulcerative colitis at the University of Minnesota Hospitals, Minneapolis during the 10 year period ending January 1, 1944 revealed that 57 patients were treated expectantly and nonsurgically throughout, or until the situation had deteriorated to a desperate point, with a 28 per cent hospital mortality and that more than one-half of the group so treated from 1934 to 1936 were dead by the time the study was undertaken. Furthermore, cancer of the colon took a high toll in all cases in which the colon was allowed to remain.

Twenty-five patients were subjected to elective ileostomy at a time when there was a reasonable choice with a resulting mortality of only 8 per cent—a decided improvement. However this method of treatment failed to salvage the diseased colon and subjected the patient to a radical and deforming surgical procedure as well as to the complications of skin erosion and ascending ileitis.

A case is presented of a 20 year old girl who had had five-sixths of the ileum and the colon removed for ulcerative colitis and who continued to suffer from ascending ileitis. Vagotomy was proposed as a possible corrective measure, and was carried out with astounding relief of the patient's symptoms. This was followed by similar treatment in 4 cases selected early in the course of their disease. These patients were followed for a period of 6 months and likewise responded very well. In view of the results, a more extensive clinical study was planned.

Twenty-eight patients who had undergone vagotomy for ulcerative colitis were studied. These patients presented many phases of the disease, and 4 died. In one case death occurred before surgery could be attempted, and this case is not included in the study. The 3 remaining deaths were caused by (1) apparent auricular fibrillation, (2) intra-abdominal abscess and fistula between the ileum and sigmoid presumably present before vagotomy, and (3) recurrent intestinal obstruction apparently related to previous abdominal surgery. Twenty-five patients remained for follow up study. Vagotomy alone was done in 16 of these, 4 of whom were not completely asymptomatic after surgery. 5 patients are unimproved and the remaining 6 showed marked improvement, as did many of the patients who had already undergone an ileostomy or an ileostomy concomitantly with the vagotomy.

Certain of the special studies of these vagotomized cases reveal interesting facts. The average weight gain was 15 per cent. Proctoscopy revealed improvement in the rectal mucosa in 7 cases, and complete healing in 4 cases. In 2 there was no improvement and in 3 the mucosa appeared worse.

Roentgen changes were striking and showed improvement in all but one case. The response was

best in those cases in which preoperative study did not reveal complete loss of distensibility and haustral markings of the colon.

Stool examination revealed less frequent blood, pus, and mucus after vagotomy but none of the patients was entirely free of all three constituents.

An attempt was made to evaluate the transit time of food through the various segments of the gastrointestinal tract. Gastric delay in emptying after vagotomy is well known. The mean small bowel passage time increased from 3.5 hours to 7.5 hours, and the colon passage time from 3.1 hour to 11.5 hours.

The mechanism of improvement in ulcerative colitis following vagotomy is unknown. That the vagal effect and fibers, thought to end in the mid-colon, probably extend to the anus is very likely.

The patients with ulcerative colitis who showed the greatest improvement following vagotomy are those with the earliest signs of the disease and the least permanent changes in the colon.

FREDERICK C. HOBBS, M.D.

**Volvulus of the Cecum.** CLAUDE F. DIXON and ALFRED C. MITCHELL. *Surg Clin. N. America*, 1948, 8, 933.

Twelve cases in which volvulus of the cecum was encountered at the Mayo Clinic were analyzed. In all cases failure of normal fixation of the cecum was manifested. Eleven of the 12 patients had had previous operations. 10 of them abdominal, and in 2 cases volvulus occurred in the immediate postoperative period.

The signs and symptoms of volvulus of the cecum are those of a low intestinal obstruction, but absence of vomiting and passage of gas and fecal material by rectum do not preclude diagnosis early in the disease.

Occasionally diagnosis of volvulus of the cecum may be made on roentgenographic examination. A hugely distended loop of large bowel is apparent and the presence of gas in the small intestine is evident but the colon is not distended.

Simple detorsion and fixation if possible are the best treatment in the absence of gangrene. Resection over a three-bladed clamp is the safest procedure when gangrene is present.

Intermittent volvulus of the cecum does occur. A new operative procedure is suggested for its correction.

**Certain Considerations of Acute Volvulus of the Cecum (Quelques considerations sur les volvulus aigus du cecum)** JEAN SÉDQUET and MARCEAU COUDRE. *J. chir. Par.* 948, 64, 409.

A review of 4 cases of acute volvulus of the cecum, collected from the literature, is supplemented by 6 case histories from the authors' material.

In some instances the cecum may be rotated as much as 720 degrees. In 4 of 6 cases the distended cecum formed a right angle with the ascending colon. The author states that the length of the mesocolon represents the radius of the arc described by the cecum in its migration; that distention of the right

colon always provokes a certain degree of rotation, and that gaseous distention is not the only cause of volvulus excessive peristalsis being an important factor.

Volvulus of the cecum occurs with approximately equal frequency in men and in women and the majority of patients are over 30 years of age. Usually the general condition of the patient remains good for a relatively long period of time.

Two roentgenologic signs are of great diagnostic importance:

1. Empty space in the right iliac fossa and the presence of incisurae characteristic for the colon, namely coarser, farther apart and more shallow than those in the ileum.

2. If scout pictures of the abdomen do not furnish sufficient information, pneumoperitoneum has not occurred and the general condition of the patient is satisfactory, a barium enema may be employed. No barium is allowed to pass the obstacle in the ascending or transverse colon.

Operative relief of torsion must be supplemented either by a cecostomy or if this is impossible a cecostomy or hemicolectomy. Cecostomy permits immobilization of the cecum and better drainage than that which is obtained through a colon tube introduced through the rectum. Cecostomy is indicated especially in advanced cases of volvulus; it should be done through a special incision. As a rule the cecostomy closes spontaneously. Hemicolectomy is indicated when an abnormally long gut is implicated or when the vitality of the affected cecum is greatly impaired. Exteriorization is condemned.

The authors believe that prophylactic treatment is of great value. An ectopic cecum which is recognized clinically, roentgenologically or in course of appendectomy should be properly immobilized. Repair of a sliding hernia should be supplemented by immobilization of the cecum and the adjoining portion of the colon.

Of 44 patients 10 whom the evolution of the condition could be followed 12 or 27 per cent died from volvulus. JOSEPH K. NARAT, M.D.

#### **Surgical Management of Carcinoma of the Colon and Rectum.** T. E. JONES, *Surg. Clin. N. America* 1948 28: 1159

Improvements in the surgical management of carcinoma of the colon and rectum during the past 25 years are attributed to improvements in surgical technique and the application of physiologic principles to the preoperative and postoperative care. Early diagnosis by virtue of improvements in roentgenology and in the allied fields of medicine also has been a contributing factor.

A further plea is made for early diagnosis on the part of the practicing physician, since many patients who reach the surgeon in an inoperable condition have been examined previously.

As to the choice of operation, the one fundamental prerequisite is an extensive and as radical an operation as possible. Whether this is done by the closed

or open method, by the one-stage or two-stage method or by any other technique makes little difference provided the surgeon can show that his results from the standpoint of mortality and morbidity are equal to those of other techniques. Perfecting one technique is considered by the author as more desirable than trying every new procedure that is introduced. The type of procedure must fit the needs of the patient. Obstruction, subacute perforation or fixation must alter the course of even the strongest advocate of the one-stage procedure. Eventually less depends on the method used than on the manner of its execution. The mortality figures in recent years show a range of 10 to 25 per cent for the same operation. The author feels that this disparity is probably due to the manner of execution.

One of the greatest difficulties of resection of the right colon, particularly in the very obese patient, is peritonealization of the right gutter. Improperly completed, it will lead to adhesions and obstruction, a definite factor in mortality. For several years the author has obliterated this complication by the use of the modified Mikulicz pack. This pack prevents the small intestine from becoming adherent to the area and the postoperative convalescence is therefore much smoother. The technique for the use of the pack is reviewed. With careful postoperative attention the cavity created by the pack assumes the shape of a vertical sinus within a week, and the wound is entirely healed in 6 to 10 weeks. In selected cases the omentum can often be employed to cover denuded surfaces. When its use is favorable, no problem exists. In resection of the right colon for growths in that area the author does not employ a two-stage procedure unless there is obstruction or perforation of the growth.

In the operative treatment of lesions of the transverse colon it is important to carry out a complete temporary tube cecostomy in conjunction with a one-stage procedure. Resection is performed in the manner best suited to the case. If the cecostomy tube is removed on the fifth or sixth day the stoma will be closed by the time the patient is discharged from the hospital. In cases of marked obstruction, which is generally not the rule, the tube cecostomy should be performed first under local anesthesia, followed in a week by resection.

In regions of the splenic flexure mobilization may be difficult because of adhesions to the spleen and it may be necessary to remove the spleen with the lesion.

In the treatment of lesions of the descending colon and sigmoid the author has come to prefer the Rankin modification of the Mikulicz procedure. Since this modification has been employed the mortality for resection of lesions in this area has dropped from 14 per cent to 5 per cent.

The author reiterates his firm conviction that the treatment of carcinoma of the rectum and rectosigmoid is the one-stage abdominoperineal resection (Miles). In a series of over 1,000 cases, the mortality was 7.2 per cent. One hundred and thirty-seven

consecutive patients were operated upon without a single fatality.

"None alone will tell whether the mortality morbidity and curability justify" the employment of sphincter-saving operations.

HAROLD LAUFMAN, M.D.

### LIVER, GALL BLADDER, PANCREAS, AND SPLEEN

On Surgically Treated Hepatitis. STEEN BRATTSTRÖM  
*Acta chir. scand.*, 943, 97-53.

The author cites earlier reports in the literature of acute hepatitis with a prolonged course in patients who were treated by means of perfusion of the biliary passages with good results. The beneficial effect has been ascribed to the washing away of an assumed mucus plug in the choledochus which constituted a relative obstruction to the biliary flow when secretion pressure was lowered by primary hepatitis. In this connection a brief account is given of recent French studies on the physiology and pathophysiology of the biliary passages by means of cholangiography and manometric measurements during operation. The authors of these studies stated they were able to show that a condition of dystonia within the biliary passages, or disturbances of the neuromuscular co-ordination in the sphincter system play an important role in the origin and course of certain cut prolonged hepatic conditions.

Experience suggests that a closer analysis of the dystonias, by means of cholangiography and manometric measurements of pressure conditions during operation, would facilitate to a rational surgical therapy in certain conditions of hepatitis by indicating vagotomy, splanchicotomy or epiploctomy. Experience already gained in this field affords further clarification of the beneficial effect of external drainage of the choledochus, long recognized in several quarters.

From the surgical department of Helsingborg's County and Municipal Hospital the author reports 4 cases in which the clinical diagnosis was acute hepatitis and the surgical procedure consisted of drainage of the choledochus. In all of the cases, biopsy of the liver was done at operation, and the 13 surviving patients were re-examined. In 13 cases intervention resulted in immediate improvement, although in several instances there were serious microscopic changes and the biopsies revealed parenchymal lesions. Two patients subsequently developed cirrhosis, and after a lapse of 6 months one had a rekindling of the hepatitis.

The author stresses the importance of the dystonias of the biliary passages in certain prolonged cases of hepatitis and points out that in many instances these are amenable to surgical treatment, and that conservative therapy should not be pursued unduly long as disastrous effects on the liver parenchyma may ensue.

Cholangiographic and manometric studies during operation may on careful analysis, afford indica-

tions for intervention involving the vagus, the splanchnicus, or the sphincter of Oddi. Proving further experience of these measures, external drainage of the choledochus provides a fairly safe procedure which undoubtedly has a beneficial effect on the hepatic process. BENJAMIN GOLDMAN, M.D.

Gangrenous Cholecystitis: A Clinical and Pathologic Study of 180 Cases. LEONARD C. HALLIDAY, MALCOLM B. DOCKERTY and JOHN M. WATSON. *Surg. Clin. N. America*, 943, 21-979.

The series of 100 cases studied by the authors represented about 2.5 per cent of all cases of cholecystic disease in which operation was performed, and constituted about 33 per cent of all cases of acute cholecystitis in which surgical exploration was performed at the Mayo Clinic. Males and females were affected about equally while 57 per cent of the patients were more than 50 years of age. The symptoms were severe when the patients were seen early; in delayed cases the symptoms were often minimal.

A palpable gall bladder was present in 30 per cent of the cases. Obstruction of the cystic duct was present in 93 per cent of cases, while in 89 per cent the obstruction was due to a gallstone impacted in the duct. Perforation of the gall bladder was present in 24 per cent of the cases (there were no free perforations in this series).

Histologically there were massive necrosis, congestion, edema, hemorrhage, thrombosis, fibrosis and subintimal arterial edema and proliferation. Infiltration of polymorphonuclear cells, indicating infection, was present in 41 per cent of the cases.

Cholecystectomy although difficult in some cases, was done in these 100 cases with 3 deaths.

It was concluded by the authors that most cases of gangrenous cholecystitis are primarily obstructive in nature, because of a stone in the cystic duct. Infection is commonly present, but seems to play a secondary role. Circulatory lesions are predominant, and perforation is frequent. Generalized peritonitis is rare presumably because of the walling-off influence of the surrounding structures. The treatment of choice in gangrenous cholecystitis is early operation; the operation of choice is cholecystectomy although in selected cases cholecystostomy is advisable. The results of cholecystectomy in cases of gangrenous cholecystitis are generally good. The best treatment for gangrenous cholecystitis lies in prophylaxis, which consists in cholecystectomy early in the course of the disease. Eighty-eight per cent of this series of patients had had previous attacks.

External Choledochoduodenostomy (Die Choledochoduodenostomia externa) P. E. SCHMIDT. *Cabert*, 1943, 19-257.

Following a brief review of the frequently clashing opinions as to the proper indications for external choledochoduodenostomy, the author defines his purpose to be that of extending the indications for this operation beyond that of an emergency procedure, especially as a primary as opposed to a secondary

intervention. The latter often comes too late to be of benefit to the patient.

The author presents 13 cases of external choledochoduodenostomy, the postoperative duration of treatment of which averaged 25.9 days. There were no deaths. In 1 case the choledochoduodenostomy was performed as a second operation and in another case as the third operation on the biliary tract. In 11 of the 13 cases clinical and operative findings were most serious. There was no case of bile peritonitis.

The author believes that this operation is indicated in patients in poor general condition rather than for drainage of the choledochus. Prolonged bile deficiency leads to digestive disturbances as well as disturbances in blood regeneration and calcium metabolism. Laterolateral anastomosis to the posterior wall of the duodenum will help to prevent constriction of the site of anastomosis. Also tension must be avoided. The author did not mobilize the duodenum, always employing a supraduodenal anastomosis. A transverse incision of the choledochus was made. Suture was performed in two layers, one with catgut (the internal layer) and the other with silk. Neither a biliary fistula nor peritonitis was observed. The internal suture with catgut is the surest guard against fistula stricture, or recurrence of stenosis.

Three of the patients suffered from cholangitis and 3 others had symptoms of damage to the parenchyma of the liver. In all of these cases choledochoduodenostomy brought prompt recovery. The same was true of patients operated on during jaundice. Also cholangitis responds to this procedure, if it is done promptly before the walls of the bile ducts become rigid with cicatricial changes. No cases of ascending postoperative cholangitis were observed. The anastomoses in this series were performed for cholangitis parenchymal damage to the liver and abscesses as well as perforations into the intestine and liver and for massive displacements of the biliary and hepatic ducts due to calculi and cicatricial changes in the papilla of Vater. Not a single biliary fistula was observed and not a single case of hepatobiliary dysfunction. There was no bile peritonitis and no abscess of the abdominal wall or cicatrice. There was 1 wound fistula at the site of drainage. The advantages of suture in 2 layers with the inner layer of catgut, are stressed.

EDITH SCHWARTZ MOORE.

#### The Quantitative and Qualitative Control of Bile Flow and Its Relation to Biliary Tract Surgery R. RUSSELL BEST. *Ann Surg.*, 1948, 128 348.

This study is based upon the premise that many of the recurrent or remaining symptoms following gall bladder and common duct surgery are caused by small retained stones and debris or the recurrence of such stones and debris because of slow flow of viscous bile low in quality and high in total bile solids. The rate of flow is also affected by spastic or atonic conditions of the sphincter of Oddi and of stricture or narrowing of the common duct.

It is assumed that if the flow of bile could be qualitatively controlled it would be possible to prevent development of biliary tract stones. This has never been accomplished to date, but a bile can be produced which is thin and watery and less conducive to stone formations by the choleretic effect of bile and bile fractions. Likewise, the quantity of bile and thus the rate of flow through the bile ducts can also be controlled.

The physiology and chemistry of bile and bile fractions is reviewed in relation to the quantity of bile and the quality of the bile produced when these fractions are taken by mouth. Experimentally ox bile salts (this is unoxidized conjugated glycocholic and taurocholic acid) given orally increases the volume of bile 36 per cent, increases the total solids 22 per cent and increases bile viscosity. Dechad (oxidized conjugated bile acids) increases bile volume 39 per cent and total solids 2 per cent, but does not change the viscosity.

Ketochol increased the bile volume 90 per cent, reduced the total bile solids 8 per cent and reduced the viscosity of the bile. Decholin increased the bile volume 106 per cent reduced the solids 22 per cent reduced the bile viscosity and was the only one tested that reduced the cholesterol content of the bile.

The last two products are recommended for use in "flushing" the bile ducts and for reduction of the incidence of stone and sludge formation. The author outlines his method of using either of these two products in combination with atropine and nitroglycerin to "flush" the biliary system, and indicates that he uses it routinely following biliary tract surgery. It is used preoperatively in some cases and periodically in cases in which the common duct has been reconstructed over a vitallium tube or other foreign material likely to become encrusted with precipitation of bile contents. The results as illustrated are good.

FREDERICK C. HOEDEL, M.D.

#### Reconstruction of the Bile Ducts (Beitrag zur Problem des Gallengangesersatzes) GERHARD KREISL. *Chirurg*, 1948, 19: 261.

On the basis of 3 personally observed cases the author discusses the reconstruction of extensive defects of the biliary tract reaching almost to the portals of the liver or directly to them. Two methods of bridging these defects are available: (1) direct anastomosis of the remaining extrahepatic or intrahepatic duct with the gastrointestinal tract, or (2) the use of prosthetic material. These two methods have been combined in the Voelcker operation. Attempts to utilize prosthetic or autoplasmic materials for such repair have yielded questionable results and involve difficult technical problems.

Any method of repair of defects in the bile ducts involving danger of stenosis with its fatal consequences should be eschewed. Methods in which the use of proper technique will obviate this risk include: 1. Anastomosis of the stump of the hepatic duct to the duodenum, employing if necessary a transi-

tory interpolation of a rubber tube according to Voelcker and thus favoring direct union. The Voelcker operation is frequently not feasible, however. The necessary mobilization of the duodenum for this purpose is frequently impossible because of adhesions.

2. Goetze's operation. Here, too, adhesions interfering with mobilization of the duodenum may prohibit this operation.

3. Anastomosis between the stump of the hepatic duct and the jejunum, i.e. hepaticojejunostomy.

4. So-called hepatojejunostomy which has little chance of success.

Good results have been obtained, however, both with Goetze's operation and with hepaticojejunostomy.

The author describes a case of artillery wound in which laparotomy revealed injury of the bile ducts (th. common duct, th. cystic duct and the inferior hepatic duct). The duodenum had been torn also, although the lumen had not been injured. The gall bladder the cystic duct, and the remnants of the other ducts were removed. The very short stump of the choledochus was closed and the duodenal wall was sutured and later covered with omentum. The hepatic stump was about 1 cm. long. Hepaticojejunostomy was followed by speedy recovery. Three months later the patient reported that he was in splendid health. Exclusion of the jejunal loop renders access of the intestinal contents to the bile ducts almost impossible. This constitutes a great advantage over other biliary-intestinal anastomoses. Because of the absence of tension between the biliary stump and the highly movable loop of the small intestine, exactly approximated sutures and supplementary overcasting are possible which diminishes the danger of fistulization.

Another case in which the Goetze plastic procedure was employed is likewise described in detail. The result was successful in spite of preoperative jaundice of 6 1/2 weeks duration fever and debility. No signs of biliary stasis were observed following the operation nor of stasis of food in the bile ducts of the liver which conditions have frequently been complained of as results of this operation. The Goetze operation is very rapid as compared with hepaticojejunostomy. The two procedures have their special indications.

In certain cases the use of prostheses or autoplasmic material for the repair of defects cannot be avoided. A case is described in which severe jaundice and gall stones demanded intervention 3 months following cholecystectomy. The technique used was employed because very rapid intervention was indicated on account of the very poor condition of the patient. In liberating the neck of the gall bladder the hepatic duct and a portion of the choledochus were resected. A T-drain was inserted to replace the resected portion, one limb being inserted into the intrahepatic orifice of the hepatic duct and the other limb into the choledochus. The drain was covered with omentum in the hope of forming a sort of canal through the

tissue. After a stormy postoperative session, the patient recovered. The drain was removed and the fistula closed. Further observation will be needed to evaluate the end results of this procedure in this case. This operation should be done only as a last resort.

In the absence of an extrahepatic bile duct rest, the Goetze operation with duodenal anastomosis, or if the duodenum is immovable, a jejunal anastomosis, is indicated. When ample extrahepatic duct rests are present hepaticojejunostomy is indicated.

EDITH SCHAMBERG MOORE.

Four Years after the Reconstruction of the Common Duct with a Rubber Tube (Quattro anni dopo la ricostruzione del coledoco con protesi di tubo di gomma). ANTONIO CINQUATA. *Chirurgia*, 1945, 3, 83.

The author illustrates a case of reconstruction of the common duct with a rubber tube prosthesis. At operation an anomaly was found in which the gall bladder was interposed between the hepatic duct and the common duct, no cystic duct being present. The gall bladder was contracted, thickened, and contained stones. There were stones in the common duct also. After cholecystectomy there was a gap of 4 cm. between the hepatic and common ducts. This was bridged by means of a rubber tube measuring about 6 cm. which fitted into either end so well that no sutures were used to anchor it. The area was packed with a gauze pack and rubber drains. The postoperative course was uneventful and the gauze packs were left in for 3 weeks after which they were gradually removed in 1 week. There was very little bile drainage.

A roentgenogram taken after 5 months showed the tube to be still in place. The patient was not seen for 4 years because of the war. After 4 years, when roentgenograms were taken, the tube was no longer seen. Since the patient did not have any attack of pain which would suggest the passage of the tube the author is inclined to believe that the tube became macerated and was passed in small pieces. His postulates that the common duct regenerated over the rubber tube, the latter acting as a guide. The method of inserting the tube snugly into either end without the use of sutures and thereby avoiding necrosis of the mucosa, is considered to have played a great part in permitting the epithelial lining to regenerate and bridge the defect. The epithelial lining, in turn, was covered by connective tissue.

LUIGI J. FRODUTI, M.D.

Late Results Following Biliary Surgery (Esiti distanti degli interventi sulla via biliare). ANTONIO RUZZO. *Arch. ital. chir.* 1945, 70, 315.

The author analyzes 660 cases of biliary surgery performed at the Surgical Clinic of the University of Turin in the period from 1923 to 1946. Cholecystectomy was performed upon 530 and cholecystostomy on 86 of the patients. The others had lysis of adhesions or other procedures. The over-all mortality

was 10 per cent. However, this has been decreasing and for the last 10 years alone was 6.9 per cent.

Of the 660 patients, 350 were recalled and of these 95 reported to the clinic. They had been operated upon from 1 to 23 years previously and 54.8 per cent were completely cured, 34.7 per cent were benefited and 10.5 per cent had not been affected for better or worse by the treatment.

Among the causes for recurrent colic are the functional causes of biliary dyskinesia, which have been well determined only in the last years. By determining whether there is a hypertonicity or hypotonicity according to the studies of Mallet Guy who resorted to radiomanometry during surgery, one may attribute the cause to excessive vagal or sympathetic stimulation. These cases may then be treated by sphincterotomy or right splanchnicectomy. These methods may also become efficacious in the treatment of recurrent symptoms following biliary surgery. However, the author believes that the test itself may stimulate the complicated biliary nervous system and therefore, the diagnostic value may not be as accurate as the originator of the test would claim it to be. The author thinks that observations should be continued for some time before the test is used to determine the definite operative procedure.

LUCIAN J. FROMMELT, M.D.

**Chronic Relapsing Pancreatitis: An Analysis of 27 Cases Associated with Disease of the Biliary Tract.** EARL E. GAMBLE, M.D. and ARTHUR H. BAGGERSTOSS. *Gastroenterology* 1948 11: 1

Comparison of the clinical clinicopathologic, and pathologic features of chronic relapsing pancreatitis with associated cholelithic disease as exhibited in the 27 cases of this series with those of chronic relapsing pancreatitis not associated with disease of the biliary tract as exhibited in the 29 cases of a series recently analyzed and reported, discloses many similarities and remarkably few dissimilarities.

First the anatomic and histopathologic features of the disease in the pancreas are essentially the same in the two series of cases. Interstitial fibrosis and residual necrosis are rather constant findings. Cyst and abscess formation and the deposition of calcium occur in both. In each series the pancreatitis most often involves the entire organ but it may be largely localized to the head, body or tail and shows no distinct tendency toward involvement of that part of the pancreas in close proximity to the disease of the biliary tract, that is the head when disease of the biliary tract is present.

Second chronic relapsing pancreatitis regardless of the presence or absence of disease of the biliary tract, involves males more frequently than females and begins at all ages.

Third the clinical features of chronic relapsing pancreatitis are essentially the same in the two series.

Fourth the same sequelae due to involvement of the pancreas appear regardless of the presence or absence of cholelithic disease.

Fifth the most frequent sequelae due to pressure of the enlarged pancreas on the neighboring structures is dilatation of the common bile duct both in the series with and in the series without disease of the biliary tract.

Sixth, in cases in which painful seizures occur, the diagnosis of both pancreatitis and cholecystitis in the same patient is made difficult by the similarity of the clinical syndromes of each disease. The most frequently made diagnosis will be cholelithic disease because (if for no other reason) cholelithic disease occurs many times more frequently than does pancreatitis. However it seems clear that pancreatitis as well as complications of cholelithic disease should be strongly suspected when the painful seizures last days, not hours and especially so when the pain starts in the left upper quadrant of the abdomen and when the pain extends to the left upper quadrant, left anterior part of the chest, left side of the back or left shoulder even if cholecystitis also is present. It also is clear that pancreatitis is definitely present in cases of disease of the biliary tract when disturbance of acinar and islet function accompanies and follows acute seizures and the deposition of calcium can be demonstrated. The appearance of a rounded, cystic mass in the pancreatic region during the painful seizure or soon thereafter may have the same significance as does diabetes, steatorrhea and calcification. Finally it may be said that a high index of suspicion of pancreatitis, more careful analysis of the features of painful abdominal seizures, and careful investigation of pancreatic function in every instance of acute abdominal seizures will increase greatly the frequency with which the diagnosis of pancreatitis is made. Once the diagnosis has been made the clinician should investigate for evidences of past pancreatitis and be on the lookout for recurring attacks and sequelae of pancreatitis because pancreatitis is often a recurring and progressive disease.

Exclusion of disease of the stomach, duodenum, small and large bowel, kidneys and heart, and even of retroperitoneal disease may prove a necessary step in the diagnosis of pancreatitis especially when the patient is seen in the intervals between attacks and in the absence of diabetes, steatorrhea, and calcification. Careful notation of clinical features and appropriate laboratory data will accomplish this.

Seventh, three possible relationships between cholecystitis and chronic pancreatitis have been considered: (1) chronic pancreatitis is secondary to cholecystitis, (2) the cholecystitis may be secondary to the pancreatitis and (3) cholecystitis and pancreatitis may occur simultaneously and could well be due to the same etiologic agent.

Eighth removal of the diseased gall bladder is clearly indicated. Chronic duodenal obstruction requires some type of sidetracking operation as does obstruction of the common bile duct. Pancreatic cyst requires either internal or external drainage and abscess external drainage. Pancreatolithotomy may be feasible.

The acute exacerbation should be treated medically. Ephedrine sulfate and papaverine hydrochloride should be used for the relief of pain whenever possible. In the event such drugs do not control the distress the usual opiates must be resorted to. The intravenous administration of fluids to combat dehydration, hypochloremia, alkalosis and acidosis as the case may be decomposition of the gastrointestinal tract, and accepted measures for combating shock also are used as indicated. During the acute attack operation to drain an abscess or pseudocyst rarely is advisable. Between the acute seizures, a bland diet is given and alcohol is forbidden. Diabetes is controlled. Insufficiency of external pancreatic secretion with resulting steatorrhea and anotorrhea is treated by a high caloric, high protein, high carbohydrate low fat diet by substitution therapy in the form of enteric-coated pancreatic tablets, or by both measures.

The clinical picture, the pathologic physiology and the course or the pathologic alterations in the pancreas in cases of chronic relapsing pancreatitis are very constant regardless of the presence or absence of disease of the biliary tract.

The problems of diagnosis of chronic relapsing pancreatitis are increased by the presence of associated disease of the biliary tract. Awareness of the possibility of pancreatitis and familiarity with its clinical features, roentgenologic findings and tests of pancreatic function should lead to a correct diagnosis in a high percentage of cases.

Treatment of chronic relapsing pancreatitis associated or unassociated with disease of the biliary tract is the same except that there is need for surgical removal of the diseased gall bladder.

Evidence has been cited supporting the thesis that in chronic relapsing pancreatitis, disease of the biliary tract may be secondary to that of the pancreas.

**Splenic Panhematopenia.** S. VAN CREEVELD. *Arch. Dis. Child.*, Lond., 1943, 23, 163.

Primary splenic panhematopenia may be congenital or acquired. If acquired, it may arise acutely or it may be secondary to pre-existing enlargement of the spleen. Proof that the dysfunction of the spleen is primary is provided by the favorable effect of the removal of the spleen and any accessory spleens. The condition is characterized by a striking decrease in erythrocytes, leucocytes, and platelets, and can be differentiated from aplastic or hypoplastic anemia by the finding of hyperplastic bone marrow.

In splenic panhematopenia which is secondary to splenic enlargement, removal of the spleen does not remove the original cause of the enlargement of the spleen, but it may improve the clinical state and prolong life.

Two cases are reported—one of primary splenic panhematopenia (secondary to splenic enlargement) and the other of secondary splenic panhematopenia due to hemolytic jaundice. In both cases, splenectomy gave excellent results. SAMUEL KATZ, M.D.

**Splenectomy: When Is It Indicated?** FRANK H. LARRY and JOHN W. NOTECROSS. *Ann. Surg.* 94, 123, 363.

The authors' discussion of indications for splenectomy is divided into three groups. Group 1 includes splenectomy for trauma, primary tumors and cysts in the spleen, wandering spleen, and to add to the completeness of radical gastric surgery for malignancy or to facilitate surgical exposure in the left upper quadrant of the abdomen.

Splenectomy for trauma may be accomplished more quickly and bleeding may be controlled with less difficulty if the spleen is approached directly by separating the lateral peritoneal reflection and swinging the spleen and its pedicle medially into the operative field. The pedicle may then be ligated directly. This exposes the renal pedicle which, in direct force injuries, is frequently injured simultaneously and must therefore be examined during surgery.

Group 2 includes those cases in which abnormal splenic physiology affects the peripheral blood cells or the bone marrow and the production of red and white blood corpuscles and the platelets. This group which once included only congenital hemolytic anemia and idiopathic thrombocytopenic purpura must now be expanded to include certain other types of hypersplenism. It is essential in all cases in this group that other factors possibly responsible for the disease be carefully scrutinized, and that careful peripheral blood studies, and particularly bone marrow studies, be made. The co-operation of the surgeon and the physician is imperative.

Congenital hemolytic anemia, an hereditary abnormality in which the blood cells are spheroid and smaller than normal, is accompanied by jaundice and increased urobilinogen output in the urine and by perbilirubinemia, due to increased hemolysis. The bone marrow shows normoblastic hyperactivity. Splenectomy in these cases resulted in 90 per cent cure and improvement in the other 10 per cent of patients.

Acquired hemolytic anemia, acute or chronic, will rarely respond well to splenectomy if the cases are carefully selected. It should not be done in malignancy, infection, or in parasitic diseases producing hemolytic anemia.

Idiopathic thrombocytopenic purpura is a hemorrhagic disease of unknown origin. If the bone marrow reveals plentiful megakaryocytes with little platelet formation at the periphery and no evidence of infiltrating disease in the bone marrow (if the eosinophils are not increased, and all studies reveal the condition to be idiopathic, it will respond well to splenectomy). The response is usually prompt following surgery. Surgery is rarely delayed and relapses may occur even years following surgery.

Idiopathic neutropenia, when other causes of neutropenia are carefully ruled out and the bone marrow is normal or shows hyperplasia of granulocytic cells, is included in the group for surgical consideration. Response to splenectomy is prompt and results appear to be lasting.

## MISCELLANEOUS

In primary splenic panhematocytopenia all of the main cellular elements of bone marrow are depressed in the peripheral blood. The etiology is unknown. Congenital and acquired types are described. In either type the bone marrow demonstrates hyperplasia of all three elements. Response to splenectomy is prompt.

Secondary splenic panhematocytopenia may rarely (in selected cases) respond well to splenectomy.

Group 3 includes the congestive splenomegalies and splenomegalies of unknown origin. In the congestive group there is portal hypertension, gastric and esophageal varices likely to hemorrhage and occasionally panhematocytopenia. Splenectomy is generally recommended to control the panhematocytopenia and may be indicated for other reasons in selected cases. The decision is a difficult one and the mortality of 8 per cent, which is higher than in the other groups, makes the decision a more serious one. The results obtained in selected cases have been fairly good.

Splenomegalies of unknown origin must be studied thoroughly and observed for at least 6 months and none of the contraindications for surgery must be present if the patient is to be submitted to splenectomy. However operation is helpful in selected cases and frequently may result in the removal of an early localized malignant tumor or give early treatment to a congestive splenomegaly.

Agnogenic myeloid metaplasia is a contraindication to splenectomy because the spleen has taken over the function of the bone marrow. Leucemia, lymphoblastoma, polycythemia vera, splenomegalies in infection, Mediterranean and sickle cell anemia and paroxysmal nocturnal hematuria usually are serious contraindications to splenectomy. One must also weigh operative hazards against the problematical benefit of splenectomy in each case.

The complications which have proved most common to splenectomy are hemorrhage, thrombosis and infection.

Three operative variants are described: (1) ligation of the lienal artery close to its origin; (2) ligation of the lienal artery by deliberate exposure of the artery at the tail of the pancreas; and (3) the rapid approach herein described.

FREDERICK C. HOWELL, M.D.

Operative Treatment of Abdominal Obesity Especially Pendulous Abdomen. *JAMA* *FOGDO. Aca med sci.* 1948 131 Supp 213 p 130.

Operative treatment for pendulous abdomen or for diffuse venter propendens was carried out on 35 patients. All of the patients were women. The indications for operation depend upon the severity of symptoms and the operative risk. The risk is comparable to that of operative treatment of any large hernia, including umbilical hernia, and the same contraindications hold for both lesions—advanced age, cardiovascular disease and chronic bronchitis being the most frequent contraindications. Intertrigo should be corrected before operation.

The various operative methods are all based on the same principle, namely excision of the superfluous subcutaneous adipose tissue and skin, and vary merely in the way of incision and its localization. The technique varies according to whether the umbilicus is left untouched, is transposed or eradicated. The two most important principles are thorough asepsis and minute hemostasis. The outlines of incision are made preoperatively with the patient in an erect posture. In the majority of these patients the technique described by Jolly was used. Compressing bandages were used and the patients were permitted out of bed the day after operation.

A survey of results in 38 operations on 35 patients revealed that the weight of removed tissue varied from 600 to 6 500 gm., averaging about 2,500 gm. None of the patients died and in 31 cases the postoperative course was uncomplicated with primary healing of the wound. There was 1 case of shock and 1 case of multiple pulmonary infarcts. There were 2 cases of marginal necrosis of the skin, 2 cases of hematoma formation and 1 case of suppuration. In only 1 case was there a complication of a serious character. The immediate result was satisfactory to both the patient and the surgeon in 33 cases, the result being classified as unsatisfactory in the case of wound suppuration and the 2 cases of marginal necrosis, respectively. A follow-up of 17 patients for a period of from 6 months to 6 years revealed no recurrence and the result was considered good in 16 patients.

JOHN L. LINDQUIST, M.D.



# GYNECOLOGY

## UTERUS

**A Correlative Study of Adenomyosis and Pelvic Endometriosis, with Special Reference to the Hormonal Reaction of Ectopic Endometrium.**  
EML NOVAK and O. ALVES & LIMA. *Am. J. Obst. Gynec.* 94:3, 56-634

This study is based on the analysis of the ectopic endometrium of adenomyosis and pelvic endometriosis as compared to the surface uterine endometrium of 343 patients who were operated upon in the private service of the senior author in Bon Secours Hospital, Baltimore, Maryland in the 8 year period extending from 1938 to 1946.

This analysis reveals that the endometrium located within these endometrial implants (both adenomyosis and pelvic endometriosis) is usually of an immature variety. Its immaturity is evidenced by the fact that it is physiologically responsive only to the growth stimulus of estrogen, and not to the differentiating influence of progesterone.

In this present series the ectopic endometrium showed no histologic evidence of secretory activity in any case regardless of whether or not the surface mucosa was of a secretory type.

JOHN R. WOLFE, M.D.

**Fibromyoma of the Uterus During Pregnancy and in the Puerperium (Fibromioma uterini in gravidanza ed in puerperio).** G. TARISCO. *Ginecologia Tor.* 94:3, 4-57

Nine women, all over 3 years of age presented themselves at the Ospedale S. Spirito, Casale Monferrato, Italy. All had uterine fibromyomas and had become pregnant. Four were treated by subtotal hysterectomy and 1 was treated by total hysterectomy. In 3 a myomectomy was done and in 1 of these the pregnancy then went on to term with birth of a living child, while in the third of these cases abortion occurred 10 days later.

The ninth case reported was especially interesting from the therapeutic standpoint. Following an amenorrheal period of 6 months the pregnant woman presented herself with nearly continuous pains in the lower and midabdominal cavity. Clinical and roentgenological examination disclosed in addition to the pregnancy the presence of a double fist-sized mass in the region of the fundus of the uterus. The advanced age (43 years) in this instance made continuation of the pregnancy seem desirable. Sedatives were given and the patient was counseled to report periodically. Instead the patient did not appear until well advanced in labor with a history of more than a month of diffuse abdominal pains and irregular elevations of the temperature. Forceps were applied at the outlet. That same day symptoms of intestinal occlusion developed and the following day a laparotomy was carried out. The peritoneal cavity

was found to contain turbid fluid, the small intestines were markedly congested and dilated and the entire abdominal cavity was involved in adhesions. An ileostomy was all that could be accomplished, the patient dying 5 hours later. Autopsy disclosed a subserous fibroid on the posterior wall of the uterus. This mass was twisted 90 degrees. The capsule had broken through giving vent to reddish-gray colligative masses with stubborn adhesions to the greater omentum, descending colon, and sigmoid.

The author believes that in special cases a waiting period may be advisable until the period of viability of the fetus, the patient always being under constant supervision followed by a cesarean section with myomectomy or hysterectomy as indicated. In most instances, however, the patient should be operated upon early in pregnancy and if possible a myomectomy should be done. In the cases in which the number or location of the fibroids make the birth of a living child improbable an immediate hysterectomy is the only recourse.

JOHN W. BRENNAN, M.D.

**The Relations Between Development of Carcinoma and Colposcopically Demonstrated Atypical Epithelium of the Portio (Ueber die Beziehungen zwischen Karzinomentwicklung und dem kolposkopisch gefundenen atypischen Epithel an der Portio).** G. MEYERHOFFER and A. MEYERHOFFER. *Geburtsh. & Frauenk.* 94:7, 7-58.

Opinions regarding the benign or malignant nature of clinically and histologically demonstrated changes in the epithelium of the portio are frequently widely divergent. In practice doubtful findings are usually interpreted as carcinomatous. Any confirmation of this conclusion from the further clinical course appears problematic, since, whereas a 5 year survival is usually considered a cure, the malignant transformation of the portio lesions may require a longer time. On account of discrepancies in the interpretation of histologic findings in the diagnosis of portio carcinoma other diagnostic aids are recommended. Macroscopic speculum examination of the os uteri and its vicinity with a colposcope will permit a final diagnosis in the living. By this method a suspicion may be confirmed or rejected. For this reason, a colposcopic examination should be made before a biopsy specimen is taken for histologic study and removal of the colposcopically demonstrated suspicious area should be done under colposcopic control. If colposcopic findings require histologic interpretation, the mucosa can be examined in serial sections, which will clarify many problems concerning the histogenesis of carcinoma of the portio. No superficial scraping of the epithelium or tiny excision from the portio will suffice. The entire epithelium of the surface of the portio including its substrate and transition to the cervix must be included. The

studies of Hinselmann, Franqué, Leip and Otto are reviewed. Survival in untreated cases of carcinoma of the portio averages from 15 to 2 years. The interval between the first stages of malignancy and the first clinical symptoms of the disease is not known. Leucoplakia may be present for years before undergoing malignant transformation. Whether early stages of leucoplakia can be considered as benign is uncertain. In the present authors' opinion the potency of the epithelium cannot be determined from the momentary status of the histological section. Histologic pictures of leucoplakia in its early stages, later developing into carcinoma, are extremely rare. Hinselmann has demonstrated histologically the development of a carcinoma from matrix areas and has, probably for the first time in the literature, followed a case histologically over a period of several years. He emphasizes the importance of following up histologically examined matrix cases. By means of histologic control examinations Schmidt repeatedly demonstrated development of carcinoma on the basis of vulvar leucoplakia.

The authors describe in detail 2 cases histologically controlled since 1937. In these cases the stages of atypical portio epithelium were followed up histologically progressively in their relation to pavement cell carcinoma of the portio. Variations in growth tempo seem possible. The present study would not seem to justify a distinction between the different stages of atypical epithelium. In many cases the matrix areas have been present simultaneously and adjacent to each other. The authors believe that there is no justification for designating atypical epithelial changes as benign, harmless or malignant.

They should preferably be considered as a whole as matrix areas of pavement cell carcinoma of the portio as a unit with gradual variations of malignant potency.

It is emphasized that if all colposcopically visible atypical epithelium be removed for histologic examination, it would be impossible to demonstrate any developing potency of the atypical epithelium. If only partial segments are removed at various intervals it will be impossible to determine the stage of development of the areas left in situ.

Biopsy must be performed only on the strictest indications. The associated dangers have often been stressed. Obligatory preliminary examination and colposcopic control should determine when and how a biopsy should be done. In this way many superfluous biopsies should be avoided and an epidemic of portio amputations prevented.

In the first of the 2 cases here reported, the development of carcinoma of the portio from colposcopically demonstrated matrix areas was followed colposcopically and histologically for nearly 6 years. In the second case, colposcopic and histologic control permitted detection of a microcarcinoma 8 months after surgical removal of a colposcopically demonstrated microcarcinoma. The first operation consisted in abrasion and amputation of the portio. Following detection of the last tumor a total vaginal

extirpation was done and followed by postoperative radium and x-ray therapy. In all, 2,422 serial sections of this portio were studied.

EDITH SCHANCHER MOORE.

**The Problem of Early Diagnosis of Cancer of the Uterine Body and Cervix** (Problema do diagnóstico precoce do câncer do corpo e do colo uterino). ARNALDO DE MORAES. *Am. bras. gín.*, 1948, 13, 1.

By early diagnosis the author does not mean early clinical but early histologic diagnosis during the asymptomatic phase of cancer. This object can be attained by periodic examination of all women over 35 years of age by colposcopy, colposcopytology and biopsy if indicated.

Colposcopy introduced by Hinselmann in 1924 is generally accepted in Europe but has met with little enthusiasm in the United States. It is regarded as a valuable aid in South America.

Colposcopytology introduced by Stockard and Panicolaou in 1917 offers a simple method of studying the cells desquamated from the initial cancer lesions and found in the material which collects in the vaginal cul-de-sac. A small quantity of this material is spread thinly on a slide fixed with equal parts of alcohol and ether and treated with Panicolaou's trichromic stain or any of its modifications. The cancerous cells mixed with the normal ones, stand out because of their great difference in aspect and staining. They may assume the most bizarre forms: elongated like rods or muscular fibers and triangular resembling tadpoles. Intense vacuolization of the cytoplasm is frequent. However the most striking aspect is that of the nuclei which are always larger and more deeply stained than those of normal cells; their contour is irregular assuming monstrous arrangements; the chromatin is disposed irregularly in large granules or there may be just a dense spot that is strongly stained. Atypical mitoses result in deformed pictures: the abnormal fragmentations or the amitotic divisions give rise to inter-nucleated cells with the nuclei differing one from the other. To complete the picture there are large amounts of pus cells and there are always red blood cells. De Moraes also collects material from the cervical canal by means of a probe wrapped with cotton wool and from the uterine cavity with a non-cutting fine curet similar to that of Cary. From his own experience and study of that of United States authors he is able to stress the real value of colposcopytology in the diagnosis of early cancer. Because of its great simplicity this examination should be the first to be made and should be used generally in women over 35 years of age even if they do not have any gynecologic symptoms. Positive or suspicious findings should be verified by colposcopy and biopsy. In the follow-up of patients irradiated or operated upon for cancer the method is of value for the control of the cure or the investigation of recurrence.

Histologic examination of a biopsy specimen is indispensable to establish the diagnosis of cancer. The present tendency is to regard as incipient cancer

even the intraepithelial lesions called carcinoma *in situ* intraepithelial cancer preinvasive cancer by pertrophy of the basal layer and the cervical disease of B. wen. The histologic study of these lesions reveals that near or in, the zone of transition from the normal orifice of the cervix there is a definite abrupt change in the stratified epithelium to the epithelial type that indicates probable malignancy.

A gynecologic consultation service for the prevention of cancer should be equipped for complete careful examination of the patients including an amniotic gynecologic examination, colposcopy col pycytology and biopsy. RICHARD KIMMEL, M.D.

#### ADNEXAL AND PERIUTERINE CONDITIONS

Concerning the Symptom of Hydrops Tubae Profusum and its Significance in the Recognition of Primary Carcinoma of the Tubes (Über das Symptom des Hydrops tubae profusum und seine Bedeutung für die Erkennung des primären T. benigneum). GERHARD BECKER, Geburtsh. & Frauenh. 1943, 8, 60.

Ten cases of carcinoma of the tubes were observed during the years from 1938 to 1947. In 3 of the women, bleeding occurred after the menopause; neither the clinical study nor curettement offered an adequate explanation. In 2 of the 3 patients the correct diagnosis of tubal carcinoma was made from the symptoms alone. These patients had no typical history of pains and no palpable demonstration of adnexal tumor was observed. In 4 other patients of this group the characteristic hydrops tubae profusum, which the author prefers to designate "hydrometra tubae profusum" occurred. In the remaining 3 women the diagnosis was apparently not made prior to operation. The chief symptoms in all cases were one or more of the triad: pain, fluor tumor.

The 4 patients with hydrometra are given special consideration. In one patient curettement was done twice with negative results because no tumor was palpable. It was only later with the development of the typical profusum, that the tumor was palpable and the correct diagnosis was made (a loss of 7 months to the patient). In a second patient, a diagnosis of urinary incontinence due to cystocele was made and a plastic repair was performed. When the hydrometra did not cease a vesicovaginal fistula was suspected and the patient was referred to the author. However the fluid could be seen gushing from the vaginal cervical orifice and with descending pyelography the fluid from the vagina did not become colored. Operation disclosed a bilateral hydrosalpinx and bilateral carcinoma. In a third instance the apparent urinary incontinence from cystocele was correctly recognized however even the passing of bloody shreds did not lead to the diagnosis of tubal carcinoma. It was only the operation which led to the correct interpretation of the symptom. In the fourth patient the hydrops tubae profusum recognizable by the typical flooding resulted in the correct preoperative diagnosis. In none of these patients were tumor cells found in the discharged fluid and shreds in

none was the diagnosis made roentgenologically. In the second case cited, a hysterosalpingography showed both tubes to be normally permeable.

From these experiences, the author does not think that roentgenology is of aid in the diagnosis of tubal carcinoma however he believes that it is of value in correctly interpreting and explaining the mechanism of hydrops tubae profusum, or hydrometra.

In 6 of the 10 cases, carcinoma of the tubes was diagnosed with certainty or with great probability. The author states that an absolutely certain diagnosis of carcinoma in these cases cannot be made without the finding of cancer cells; however, in the presence of bleeding without corresponding findings by curettement, or in the presence of hydrops and of hydrometra tubae profusum carcinoma of the tubes must be suspected and treatment must be the same as though the diagnosis was absolutely certain. This treatment consists in the removal of the uterus and of both adnexa. JOHN W. BRIDGES, M.D.

The Treatment of Blocked Fallopian Tubes by Pressure Injections of Gas and Iodized Oil. ALAN GRANT and ROBERT MACART, Med. J. Australia, 1948, 2: 99.

One of the most exasperating situations encountered in sterility is that of the married couple in whom the major infertility factor operating is occlusion of the wife's fallopian tubes. An apparently simple solution to this pathological state of the tubes is some form of surgery which establishes an artificial ostium or resects the damaged segment of a tube, by the performance of salpingostomy or by tubal implantations. In practice such a procedure yields a very disappointing harvest of patent tubes and pregnancies.

It is a clinical impression that salpingostomy is a more successful operation when the tubes have been blocked by some extratubal pathological process, such as acute appendicitis, than when they are occluded as the result of a septic miscarriage or postperal sepsis, in which the normal function of the tube has been badly impaired.

In a survey of 547 cases of tubal block, tuberculosis was reported in 2 cases, placental polypus in 1 case, previous cesarean section in 3 cases, peritonitis in 3 cases, previous normal confinements in 4 cases, pelvic operations in 8 cases, ectopic pregnancy in 10 cases, puerperal sepsis in 14 cases, genital hypoplasia in 14 cases, salpingitis in 52 cases, a previous history of appendectomy in 37 cases, no known cause in 69 cases, and a previous history of miscarriage in 71 cases.

The largest group of cases published is the collected series of cases consisting of 818 plastic operations on the tubes. 54 pregnancies took place, an incidence of 6.6 per cent, or one pregnancy for every 5 operations. Complications occurred in many of these pregnancies and the ultimate successful result was one baby for every 55.5 operations.

Treatment with gas injections was carried out. The gas used was carbon dioxide and it was admin-

intered with Sharman's modification of Bonnet's kymograph. The gas was regulated to flow at 65 millimeters per minute and the pressure was taken up to the maximum of 250 millimeters of mercury. Two such insufflations were given in 10 to 12 days after the conclusion of menstruation in separate months.

The third injection was made with iodized oil, 1 month later. The injection of oil was given at a pressure of 250 to 300 millimeters of mercury in the x ray department. An x ray film was taken at the time and another plain x ray film was taken 2 days later.

HARRY W. FINE, M.D.

**On Female Sterility Due to the Congenital Obliteration of the Abdominal Aperture of the Tube. Surgical Intervention. Subsequent Pregnancy** (Sur la stérilité féminine par obliteration congenitale de l'ouverture abdominale de la trompe. Intervention chirurgicale. Grossesse consécutive) R. JOYEUX. *C. rend. Soc. fr. gyn.*, 1948, 18, 95

The frequency of sterility due to tubal obstruction according to recent reports is marked as this cause is found in from 45 to 50 per cent of all the cases.

Among all the tubal lesions which prevent conception inflammatory lesions predominate. Congenital malformations on the other hand are comparatively rare.

An unusual case treated by the author and a case he has not found recorded in the literature is reported. This case is one in which there was a bilateral congenital obstruction of the normal openings of normal tubes due to an abnormal continuation of the mesosalpinx which formed a peritoneal hood around the abdominal opening of the tubes.

This occurred in the case of a woman of 22 years, who sought relief from pain in the right iliac fossa of more than a year's duration. Married at the age of 18 she never became pregnant. Her menstrual history was normal. As physical examination revealed her genital organs to be apparently normal an original diagnosis of chronic appendicitis was made.

Hystero-graphy was performed with the finding of a normal uterine cavity and obliteration of the tubes in the vicinity of the abdominal openings of the tubes. The deformity was identical on the two sides.

Laparotomy was performed and the abdominal extremities of the tubes were found to lie in a cul-de-sac which was formed by a continuation of the mesosalpinx. There were no adhesions, no signs of inflammation, and no abnormality of the tubes or uterus. The appendix was normal. The cul-de-sacs were dissected out with evacuation of the lipiodol used in the hystero-graphy. The tubes were readily catheterized. Incidental appendectomy was performed. Postoperative recovery was normal and 3 months after the operation the patient became pregnant.

The theory that the deformity found at operation was a congenital abnormality is supported by the

following facts at operation there were no signs of pelvic or genital inflammation. There were no adhesions or encrustations of the tubes or of the mesosalpinges. The tubes were easily catheterized. There was no hydrosalpinx. The lipiodol was in the cul-de-sac and not in the tubes. The deformity was bilateral.

The congenital deformity found at operation led the author to find an explanation of the condition. He studied the development of the hysterotubo-ovarian ligaments in a 10 cm. human embryo. At the second month of development of the human embryo the abdominal extremity of the Muellerian duct is intimately united to the superior pole of the ovary and the Wolffian body. These organs later diverge from one another. Then the diaphragmatic ligament divides into two small ligaments, one extending from the posterior abdominal wall to the mesovarium and to the abdominal end of the tube, the other extending from the abdominal end of the Muellerian duct to the superior pole of the ovary. The diaphragmatic ligament normally diminishes rapidly. An abnormal persistence of the diaphragmatic ligament attached to the abdominal end of the tube can form a veritable hood over the tubal pelvis. It was not surprising to find that this hood was purely serous.

In this case hysterosalpingography was instrumental in disclosing the congenital deformity causing sterility.

Tubal sterility, proved by hysterosalpingography justifies surgical intervention.

BLACKWELL MAREHAN M.D.

## EXTERNAL GENITALIA

**The Treatment of Chronic Bartholinitis; New Treatment Procedures; Their Superiority Over Classical Therapy; Question of Recurrences** (A propos du traitement des bartholinites chroniques, nouveaux procédés de traitement, leur supériorité sur la thérapeutique classique; question des récidives) MARCEL GAUDEROT. *C. rend. Soc. fr. gyn.* 1948, 18, 119.

Acute bartholinitis is essentially of gonorrheal nature at least in the beginning, and requires immediate local treatment. It should be incised widely (3 cm.) as soon as pus has gathered. Usually the wound does not close completely and suppuration continues and results in fistula formation if it closes. Recurrence is practically the rule. In chronic fistulized bartholinitis two methods of treatment are available: disinfection of the cavity followed by obliteration through sclerosis and sanerization with the electric knife followed by electrocoagulation of the fundus of the gland.

The first method is indicated in all small cavities (about the size of an almond) in which probing reveals tracts that are narrow and not too deep. Disinfection is obtained by three instillations at 1 or 2 day intervals of penicillin G 5,000 units per c.c. or of soludagenan 33 per cent, which causes bleeding and sclerosis or of sulfonamide which is less expensive than penicillin and less caustic than soludagenan.

nan. If the latter is used, the disinfected cavity may be partially or completely sclerosed, but in most cases a solution of quinine and urethane 5 per cent each will have to be instilled three times at intervals of 3 days. It is essential that the entire cavity be sclerosed to avoid recurrence which occurs in 40 per cent of the cases, mostly because a glandular crypt has escaped disinfection.

The second method is used for conditions which fail to respond to the first method, and is used immediately for large pockets or multiple and large infected tracts. It is also useful as the second stage in acute infections about 8 days after the first incision. The operation is performed under intravenous or epidural anesthesia.

In chronic Bartholin'sitis in which incision has been made during the acute stage the previous incision is reopened and enlarged if necessary and the gland is marsupialized at the vulvar opening with the electric knife.

In cystic Bartholin'sitis the internal aspect of the cyst is incised along its greatest length with the electric knife. The internal wall of the cavity is removed exposing the bottom of the gland which is then electrocoagulated, with destruction of all infected glandular crypts and abnormal tracts. A dressing with a saturated solution of antipyrine is applied to prevent postoperative bleeding. This operation is benign, easy, rapid and radical; the patient may get up on the evening of the intervention and attend to her occupation the following day. Healing requires from 4 to 6 weeks. The result is excellent; the deformity of the vulva decreases in 2 or 3 months and the region assumes a nearly normal aspect. Three of 25 recent patients have needed a slight intervention after the operation—one on the third day for local bleeding, the other—on the sixth day to destroy a tract that had been overlooked.

KRUEL ED KRUEL, M.D.

### MISCELLANEOUS

**Histologic Studies in Cases of Amenorrhea Treated with Progesterone and with Parasympathomimetic Substances** (Histologische Untersuchungen bei mit Progesteron und parasympathomimetischen Stoffen behandeltem Amenorrhoeen). K. BÜCKNER and J. DUBRAUTZEN. *Gebertisch & Frauenheilk.* 94, 8, 576.

Thirty-six treatments were administered to secondary amenorrheics with histologic examination of the curetted endometrial specimens before and after each treatment. Five patients were given doryl, which is the German preparation corresponding to moryl (carbamino-cholin-chloride) for 5 days in doses of 2 mgm. thrice daily per os. In this group there was 1 instance of bleeding by diapedesis (not true menstruation). Five patients were given doryl for 5 days in daily subcutaneous doses of 25 mgm., with again 1 instance of bleeding by diapedesis. Six patients were given prostigmine for 5 days in daily injections of 0.5, 0.75, 1.0 and 1.0 mgm. subcutaneously. Two bleedings were produced in this

group. In the one there was some proliferation produced by the injections, but the bleeding was by diapedesis; in the other there was already an endometrium in the secretory phase when the treatments were instituted and in this case a true menstrual type of bleeding developed. The author does not deem this as an instance of menstruation produced by prostigmine, as it might have occurred anyhow.

Finally there were 15 patients treated with progesterone for 5 days in daily injections of 10.0 mgm. In this group there developed 3 instances of true menstrual bleeding and 7 of bleeding by diapedesis.

From these experiences the authors conclude that both the progesterone and the sympathicomimetic substances will produce a certain amount of proliferation and even some evidence of the secretory phase in secondary amenorrhea, and will on occasion produce bleeding by diapedesis—probably as a result of vascular dilatation. However they will not produce true menstrual bleeding unless the endometrium is already in an advanced stage of secretory transformation. No attempt is made to assess the psychic effects on the patient of the false bleeding. It is admitted that these substances, through their stimulative action on the parasympathetic nervous system are able to produce some stimulation of the ovarian follicle; nevertheless they are not to be regarded as suitable for the treatment of secondary amenorrhea.

JOHN W. BRENNAN, M.D.

**Report of 8 Cases Operated Upon for Vesicovaginal Fistulas, Complicated in 1 Case by a Functional Incontinence** (Comunicación a propósito de ocho casos de fistulas vesico-vaginales operadas y en uno de los cuales coexistía una incontinencia funcional de orina). JAUN WOOD WAD and RAMON DAVAZO A. *Rev. Soc. Chilena Med.* 94, 3, 16.

The procedure employed in 4 cases of vesicovaginal fistula consisted in a modified Fueth operation whereby the vaginal mucosa is separated at the fistulous orifice and the mucosa of the fistulous tract is folded into the bladder by means of an inverting suture through the basal connective tissue. No suture is put in the vesical mucosa and the vaginal margins are approximated with interrupted No. 1 chromic catgut sutures.

This method sacrifices no tissue but permits good approximation without tension or serious alteration of the blood supply.

Vesicocystostomy complemented by posterior colpoperineorrhaphy succeeded in correcting the remaining case in which urinary incontinence coexisted. The fistula was repaired by means of the modified Fueth procedure.

STEPHEN A. ZIEGLER, M.D.

**Treatment of Inflammatory Tumors of the Adnexa by Douglas Puncture and Colpotomy** (Die Behandlung der entzündlichen Adnexitumoren mittels Douglaspunktion und Kolpotomie). HERM. COETZEN. *Gebertisch & F. wch.*, 1948, 8, 165.

The therapeutic value of Douglas puncture in inflammatory tumors of the adnexa is even today a

sharply disputed question. Heynemann has recently clarified the indications for this method of treatment. Although he condemns a categorical rejection of this procedure for the cases in question, he emphasizes the fact that its injudicial application may diminish the chances of recovery. The conservative method remains the standard therapeutic procedure. Any other method including puncture of the Douglas pouch and colpotomy must be classified as general expectant and supplementary treatment. If these fail there remains the last resort of laparotomy and extirpation of the inflamed organs.

Douglas puncture is indicated when ordinary conservative measures have failed and conditions permit a technically perfect, and therefore safe puncture. The intervention must be made carefully so that it can be followed by physical therapy under medical supervision. In cases filling these requirements puncture is indicated in the presence of persisting fever and chills in patients in poor general condition or with cachexia, in the presence of intolerable pain not responding to other measures in patients with threatening perforation into the intestine, and in cases of failure of the inflammatory tumors and exudate to regress.

If possible, puncture should be done only in the chronic or subacute stages. The most meticulous antiseptic and aseptic precautions are imperative. Preoperative preparation of the patient is of the utmost importance in preventing complications. The safest site for puncture is through the posterior vault of the vagina, in the midline, about 2 cm. in back of the vaginal insertion of the portio. The cannula should be inserted to a depth of 1 cm. Blind puncture is recommended by some writers, who believe that pulsating vessels furnish a better guide and can be avoided more easily by palpatory location than by direct observation. Schultz has described the technique of the operation in detail. In the presence of multilocular processes puncture may be repeated. In some cases as many as 5 punctures have been required to locate the tumor. No undesirable reactions have been recorded. If puncture proves inadequate because of the extent of the process or the viscosity of the pus or if conditions indicate probable rapid recurrence the puncture may be followed by colpotomy and by drainage if necessary.

The incision is made from 1 to 2 cm. in length and from 0.5 to 1.0 cm. in width so that there is little danger of injury to the ureters or vessels. The packing is removed after 24 hours to prevent infection of the wound. Because of the danger of pressure necrosis, the drain should not be left *in situ* for more than 10 days. The feared complications of puncture, namely, general peritonitis or pelvic peritonitis, may

be largely prevented by aseptic technique. It is also possible that puncture may lead to the release of pus from a pyosalpinx or pyovarum into the abdominal cavity. Sudden body movements, exertion, external palpation or vaginal examination may be responsible. Usually severe peritoneal reactions do not result since the pus is encapsulated in the pouch of Douglas producing a relatively harmless Douglas abscess. Nevertheless immediate laparotomy is indicated. This possibility must be kept in mind so that perforation can be recognized immediately. With proper instruments and technique there is little danger of injury to the ureters or vessels. Perforation of the intestine may be recognized from the aspiration of feces. In this event, the operation must be discontinued and the patient put to bed with ice applications. The site of perforation is usually rapidly closed with peritonemum. Fistulization rarely results. The puncture orifice is usually closed within 24 hours. Fistulization is more apt to follow colpotomy, which should therefore be used only in cases in which puncture does not suffice. As a rule, colpotomy involves the same risks as puncture, but with the more extensive incision more severe hemorrhage may result and obliterate the operative field. Whereas Heynemann has strictly limited the indications for puncture, Conrad punctures every adnexal tumor having attained a given size and showing fluctuation. The more conservative attitude of Heynemann seems preferable.

In the author's series of 527 patients with acute inflammatory adnexitis, 63 or 12.3 per cent, were treated by puncture of the Douglas pouch or colpotomy. Ovarian insufficiency was demonstrated in 28.9 per cent of this series. It is believed that this condition impairs the powers of resistance and thus predisposes to infection. Treatment by puncture requires 31 days conservative treatment requires 29 days. Puncture yielded successful results in 65 per cent, or 41 of the cases. Transitory favorable results were obtained in 15.8 per cent. Thus good results were noted in 81 per cent of the cases. The results were doubtful in 11.1 per cent, and failures were recorded in 7.9 per cent of the cases.

Unfortunately conditions did not permit any extended follow up study of this series, so that no conclusions as to late results are available. Usually the patients were advised to continue short wave therapy, mud packs and sitz baths for a certain period of time.

Since puncture yields satisfactory results in 80 per cent of the cases and shortens the duration of treatment, it would seem a valuable procedure in the face of the rapidly increasing incidence of gonorrhea and the prevalent diminished resistance to infection.

EDITH SCHANCK MOORE.

# OBSTETRICS

## PREGNANCY AND ITS COMPLICATIONS

The Diagnosis of Sex During Pregnancy (A proposed diagnostic du sexe pendant la grossesse) A. GRANTON *Presse med.*, 918, No. 37 685.

A hormonal test for determination of the sex of the fetus has been published. The injection of 10 c.c. of urine of the pregnant woman is supposed to cause histologic changes and enlargement of the testicle in a rabbit if the embryo is male. This test however has proved unreliable in many cases.

The author believes it possible to visualize the scrotum and in some cases the penis of the fetus by roentgenography with appropriate technique. At least two or three pictures from different angles are necessary. **WILLIAM M. SOLARTE, M.D.**

Eclampsia Control. T F CORRIE. *N Zealand M J* 1943, 47 100

The author presents a résumé of an earlier survey of eclampsia in the Wellington urban area from 1928 to 1939 inclusive which showed encouraging figures for incidence, maternal mortality and infant mortality. A later analysis, covering the 8 years from 1940 to 1947 inclusive, indicates still further improvement. Among 29,645 live births, the incidence of eclampsia was 4.8 per 1,000 live births (83 cases). The maternal mortality was 4.8 per cent and the infant mortality was 20.5 per cent. The important points in eclampsia control through antenatal supervision and treatment are discussed.

Even a minor rise in blood pressure or a trace of albumin calls for rest and closer watching. Anything more demands hospitalization if possible. In cases in which 36 or 37 weeks have passed there is little advantage in delay and there should be no hesitation about termination of the pregnancy. At the present time induction of labor is the most important measure in our treatment of pre-eclampsia. In cases in which the patient is in the last month of pregnancy, termination by simple induction of labor is almost always the correct procedure although very occasionally particularly in a primigravida in whom the symptoms and signs are of great urgency and in whom the unripe condition of the cervix causes a fear of delayed response, cesarean section has a proper place.

In the treatment of actual eclampsia, the conservative method continued to be used in the great majority of cases. The only obstetrical measures sometimes used in these cases were the early rupture of membranes to relieve pressure and instrumental termination of the labor if the second stage was delayed.

There was an increase in the number of cases in which cesarean section was necessary. Whereas cesarean section was performed only once among 153 cases of eclampsia observed during the period of 1928

to 1939 it was performed in 15 of the 83 cases which occurred in the last 8 year period. In 3 cases, the cesarean sections were performed late, as a desperate measure in patients who had not responded to conservative treatment. All 3 mothers died which accounted for 3 of the 4 maternal deaths in this period. The postmortem findings make it abundantly clear that such last resort operations are doomed to failure. **GEORGE BINNETT, M.D.**

Cervical Myoma and Pregnancy (Miomu do colo gravidez) CELSO ALMEIDA DE GODOY *Rev. hep. clin.*, 918, 3 83.

Among the neoplasms of the female genital tract, 75 per cent are myomas of the uterus and these constitute 20 per cent of the gynecologic processes. The incidence of cervical myomas reported by modern authors varies from 1.3 to 16 per cent, and this lower incidence as compared to that of myomas of the uterine body is due to the difference in histologic structure of the two regions and in their vascular conditions and to the more intimate interrelationship between the ovaries and the uterine body than that between the ovaries and the cervix.

Macroscopically cervical myomas may be classified into (a) supravaginal (subserosal, submucosal, intramural, and interstitial) (b) intravaginal (submucosal, intramural, and interstitial) and (c) mixed. The myomas may consist of a single nodule, which is the most frequent form, or of several nodules which form is much rarer.

Microscopically these tumors consist initially of smooth muscle fibers, easily differentiated from those of the normal myometrium and arranged in disorderly fashion. As the tumor develops, there is marked proliferation of the connective tissue so that by the time the tumor has reached a certain degree of development it consists nearly exclusively of fibrous tissue; hence, the name of fibroma.

The etiology of cervical myoma is still unknown. Even when small, the tumor always produces symptoms which become serious in most cases: they are symptoms of compression on the urethra or on the bladder depending on the volume, the variety and the location of the tumor. The most frequent and important symptoms are dysuria, pollakiuria, hematuria, and retention. Retention may be paroxysmal or chronic. In the first, the capacity and the wall of the bladder are not altered. In the second, the capacity of the bladder is increased and the wall is thickened. Retention is progressive and is overcome only by extirpation of the tumor. Hemorrhage is rare and occurs only in submucosal tumors which cause repeated contractions of the uterus in an effort to expel them. Discharge is more frequent than hemorrhage because the myoma mechanically produces a constant state of chronic inflammation of the cervical glands.

Submucosal myomas and those assuming the form of a polyp may undergo secondary changes because of circulatory disturbances (necrosis), dilation and malignant degeneration (carcinoma). In addition, they may undergo calcification, or fatty hyaline minked or sarcomatous degeneration, or they may become infected as infection occurs more frequently in these tumors than in myomas of the uterine body because of the highly pathogenic flora of the vagina and the constant traumatism to which the cervical myomas are exposed.

The influence of pregnancy on the tumor is slight compared to that on myoma of the uterine body because it is exerted especially on the muscle fibers which are much less abundant than those in the myometrium. The influence of cervical myoma on pregnancy does not depend principally on its location and volume. Submucosal and intravaginal tumors of small size generally do not interfere with pregnancy and labor but submucosal and supravaginal tumors compromise the active segment and may cause an interruption of pregnancy by acting as foreign bodies which cause uterine contractions to expel them. If small they may not interfere with labor if larger they may be a factor in dystocia by obstruction or by preventing dilatation. Intramural tumors may disturb dilatation. A more frequent factor of dystocia. Interstitial tumors involving the entire cervix usually require intervention which in most cases is dangerous.

Treatment varies from case to case according to the symptoms, form, volume and localization of the myoma. If there is no pregnancy the tendency is toward surgery by the vaginal route for submucosal polypoid small intramural, necrosed and infected tumors, the abdominal route being reserved for all other forms. During pregnancy some authors prefer watchful waiting while others insist on removal at any time even during labor. For intramural forms expectation is best, with surgical removal after the puerperium for interstitial forms involving the entire circumference of the cervix. The author reports 3 cases.

a submucosal pedunculated polypoid myoma in which polypectomy did not interfere with the normal course of pregnancy. The other patient showed a myoma of the entire anterior half of the cervix and invading the posterior half, associated with a molar degeneration which was followed by chorioepithelioma. In this case total abdominal hysterectomy was performed.

RICHARD KEMET, M.D.

## LABOR AND ITS COMPLICATIONS

Rare Injury of the Soft Tissues in Spontaneous Delivery (Ueber eine seltene Form von Weichteilverletzung bei Spontan Geburt) | E. Orr. *Geburtsh. & Frauenk.* 1948, 8: 274.

In a primipara of 22 years spontaneous delivery was associated with development of a traumatic

rectovaginal perforation. No prior diseases, including syphilis or earlier operations were recorded. Perineal lacerations are known to occur in from 11 to 25 per cent of normal deliveries. They have been classified as first, second and third degree lacerations. The most severe type is extremely rare and includes laceration not only of the perineum and vagina but also of the sphincter musculature.

The infant in the case here described was in left vertex position. The pelvic measurements were normal. The blood pressure was slightly raised and urinary albumin and marked edema pointed to pre-eclamptic toxemia. However the blood pressure responded to rectal suppositories and the subjective symptoms subsided. No further toxic symptoms developed during labor or in the puerperium. Dilatation was complete within 8 hours.

Shortly after rupture of the membranes the head appeared. The perineum seemed adequately stretched. Before the greatest circumference of the head had emerged, the elbow and a portion of the upper and forearm appeared emerging from the anus. As the posterior shoulder progressed, the protruding elbow receded and finally disappeared completely being finally delivered through the vagina smeared with feces. The placenta was delivered without difficulty.

Inspection showed the perineum and anal sphincter intact, but with a communication measuring two fingerbreadths in width between the posterior vaginal wall and the rectum about 3 to 4 cm above the third degree perineal laceration was made by splitting the sphincter musculature. The tissues seemed extremely friable. Healing occurred by primary intention.

A review of the literature revealed a almost identical cases, with the difference that in 1 case not the elbow but the entire forearm protruded from the rectum. Analogous cases have been reported in breech presentations. In some cases syphilitic strictures have been held responsible. Pressure erosion has also been incriminated, but would be plausible only in cases of greatly protracted labor. Hyperextension of the posterior vaginal wall has also been considered as playing a part. However in the present instance spontaneous so that such a factor could hardly have been involved. Among contributing factors mentioned by various writers are a narrow vagina, edema of the labia and septum, oversized infants with very hard skulls, and simultaneous presentation of the head with some smaller part. EDITH SCHWARTZ MOORE.

Changing Trends in Cesarean Section. ABRAHAM B. TAMIS and JACOB CLARK. *Am J Obst.*, 1948, 56: 700.

In a study of cesarean section at the Morrisania City Hospital, New York, New York, it was noted that while the incidence of this operation had doubled in the last 10 years, the mortality when compared with the previous 10 years, had decreased from





# GENITOURINARY SURGERY

## ADRENAL, KIDNEY AND URETER

**Adrenal Cortical Carcinoma** ZACHARY R. COTTLER.  
*J. Urol.*, Balt. 1948 60 363.

The nonhormonal type of adrenal malignancy is usually discovered in its late stages when it becomes manifest by the presence of a mass, vague pain, malaise, and by signs and symptoms of metastasis in other organs. The diagnosis has been greatly aided by the technique of percutaneous air injection as described by Cahill and Mencher.

The treatment of the nonhormonal type of malignancies has been surgical extirpation when possible, followed by high voltage irradiation to the operative site and to metastases as they develop. The prognosis is poor because the lesions often attain large size and metastasize before presenting any symptoms.

The author presents the case of a 50 year old woman who entered the Jewish Hospital of Brooklyn, New York, complaining of falling of the womb. There was no history of urinary disturbance. A large hard mass filled the entire right side and flank. The blood pressure ranged around 150/140 during the preoperative period. X-ray studies including intravenous urography and a barium enema, showed evidence of extrinsic pressure. Upon operation the tumor was found to reach from the diaphragm to the loin with adherence to the kidney. It was removed. Microscopic study revealed an adenocarcinoma of the adrenal gland.

The patient received 100 roentgens of radiation therapy. When she was found to have a recurrent mass in the abdomen another course of 4000 roentgens was given. Metastasis to the para-aortic region of the chest was discovered 39 months after operation. At the date of the report the patient had attained 5 years of postoperative observation and is considered in fairly good general condition with a blood pressure which averages 120/80. The metastases have remained unchanged.

The author believes that renal ischemia was the cause of a Goldblatt phenomenon which accounted for the hypertension. JOSEPH E. MAURER, M.D.

**Congenital Absence of One Kidney** K. M. BOWDEN.  
*Med. J. Australia*, 1948 2 593.

The author calls attention to the incorrect statement that the corresponding suprarenal gland is always absent in congenital absence of one kidney. This statement is believed to be challengeable on several grounds.

The kidney embryologically has a double origin. From the wolffian duct an outgrowth occurs which eventually gives rise to the ureter renal pelvis calyces and the straight collecting tubules. As the ureteric bud is developing the metanephros appears and covers the growing end of this bud. This even-

tuously gives rise to the remainder of the kidney. The suprarenal gland likewise has a double origin but one that is quite independent of the developing kidney. The medulla is intimately related to the sympathetic nervous system. The cortex is of mesodermal origin and appears as a ridge close to the wolffian body. On embryological grounds therefore, there is no reason why the corresponding suprarenal gland should be absent when there is congenital absence of one kidney.

Congenital absence of one kidney is usually due to complete arrested development of the ureteric bud from the wolffian duct. There is usually no trace of the ureter and the portion of the trigone on that side is undeveloped. The reports of the incidence of this condition vary widely from 1 case in 1,000 to 1 in 2,500 individuals.

The author presents 2 case histories of patients with a congenital absence of one kidney and in whom both suprarenal glands were present.

ROBERT O. BEADLES, M.D.

**Aneurysm of Renal Artery** CHARLES PIERRE MATHÉ.  
*J. Urol.*, Balt., 1948, 60, 543.

Aneurysm of the renal artery is rare. The present report of 5 cases brings the grand total to 86 cases. In 1933 the author reported a case of aneurysm of the renal artery and reviewed the literature. Since that time he has treated 5 additional patients. The author reports these 5 cases in detail.

The first case was especially interesting inasmuch as he found, on exposing the pedicle, that the renal artery had divided into inferior, middle and superior branches. On the superior branch a saccular aneurysm measuring 1.5 cm. in diameter was encountered. The posterior surface of the aneurysm was densely adherent to a large renal vein. This was carefully dissected free, and the superior branch of the renal artery was doubly ligated below and above the aneurysm with No. 3 catgut. The aneurysm was then extirpated without sacrificing the kidney. The author's case is the second one of its kind in the history of kidney surgery.

Four other cases were also reviewed. In 2 of these the aneurysms were treated by nephrectomy. In the third case the aneurysm occurred in a ptotic kidney and sclerosis resulting from the healing process after fixation of the kidney apparently reinforced the defect in the arterial wall inasmuch as the patient has had no further trouble during the 8 years which have elapsed since operation.

For a detailed description of this condition reference is made to a communication by the author published in 1932. Articles which have subsequently appeared reveal many pertinent facts. Trauma is no longer considered to be important as a factor in the etiology of aneurysm. It is believed that most aneurysms are due to the same degenerative changes



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noted in the walls of the blood vessels that give rise to aneurysms elsewhere in the body among which arteriosclerosis and syphilis play a dominant role.

Most authors state that this lesion is asymptomatic. However a review of the symptoms recorded in published cases reveals that pain is more or less constant. In the author's 5 cases pain was a dominant factor. He believes that when a patient suffers from intractable pain in the kidney area one should not hesitate to carry out operation for the purpose of performing renal sympathectomy and at the same time the renal artery and its branches should be exposed for the presence of aneurysm.

The broken wreathlike shadow which is denser at its periphery is considered diagnostic. Brady and Hanten believe that when there is a defect in the calcified annular ring due to the connection between the aneurysm and the artery the differential diagnosis between aneurysm of the renal artery and other calcifications in and about the kidney can be positively made. Furthermore, laminograms taken in conjunction with an excretory urogram will reveal the shadow to be delineated in the same plane as the kidney. Unfortunately many aneurysms are not calcified and cast no shadow. Arteriography should be more commonly employed as a diagnostic method, particularly in patients presenting persistent renal pain in whom renal sympathectomy is contemplated. It gives valuable information concerning the distribution of the renal artery and its branches, and also may reveal the presence of aneurysm.

All authors agree that nephrectomy is the treatment of choice. Mathé emphasizes, however, that when the aneurysm involves one of the branches of the renal artery and the main branch is devoid of thrombotic changes, the aneurysmal sac can be resected without sacrificing the kidney. In the occasional case presenting a small fusiform aneurysm associated with other renal disease such as ptosis or hydronephrosis the kidney lesion can be corrected without sacrificing the organ. The fibrosis that has taken place during healing can be relied on to reinforce the defect in the arterial wall.

ROBERT O. BRADLEY, M.D.

**Renal Tuberculosis in the Child (*La tuberculose rénale nel bambino*) GIORGIO MARO *Urologia*, 1945, 5, 6**

Two thousand autopsies done on children at the Ospedale Maggiore at Milan Italy disclose that about 5.76 per cent died of millitary tuberculosis. About half of these exhibited renal tuberculosis in the first year of life. The lesions were unilateral in 75 per cent. Unilateral lesions were more frequent from the fifth to the twelfth year and were located usually in the medullary and papillary regions. Vesical lesions were observed in a third of these cases but always after the tenth year. There was only 1 case of concurrent involvement of the testicle, epididymis, and seminal vesicles, in a boy 13 years of age.

In addition to the autopsy material, there are reported 4 cases of surgical renal tuberculosis diag-

nosed clinically. This number when compared with the cases of congenital malformation and renal fistula, comprises 12.5 per cent of the whole and occupies third place. Surgical renal tuberculosis occurred more frequently in the female and predominantly in the left kidney. The lesion was always ulcerocavernous in character and in 1 case was associated with multiple renal calculi. In the latter case the tuberculous kidney was successfully removed however the patient died of anuria before the stone in the other kidney could be removed. In the case of another child the parents refused operation. In the remaining 3 cases the kidney was successfully removed with disappearance of all symptoms.

Search for the tubercle bacillus should be carried out in all children with frequency of urinary incontinence, those exhibiting a pyuria or hematuria, or in those with an intermittent or persistent pyelitis or cystitis, even when the colon bacillus or other common source of infection is established. A search should be made for the bacillus of Koch even in the presence of a roentgenologically diagnosed renal fistula. The search is particularly important in the presence of a ureterohydropyonephrosis on an apparent or sure congenital basis, since in the presence of tubercle bacilli the ureter must also be removed together with the kidney.

Once the tubercle bacillus is established in the urinary examination the establishment of the tubular nature of the lesion should be accomplished by means of descending pyelography, chromocystoscopy and ureteral catheterization of the supposed healthy kidney. If Koch's bacillus is found in the urine from this supposedly healthy kidney the diseased kidney may perhaps be removed provided that its partner exhibit good function and absence of pus. Operation in these cases requires good surgical judgment nevertheless, the removal of an ulcerocavernous lesion in the diseased kidney relieves the organism of a source of tuberculous bacilli and of toxins and renders spontaneous cure of the other kidney more easy. If the lesion in this kidney also has reached the ulcerocavernous stage such a kidney appears to be incurable with present day methods.

Another argument for nephrectomy in these infants arises from the fact that the urine of these children is a potent source of infection to others, particularly other children and the family and the younger the child, the greater the danger.

Close co-operation between the pediatrician and the urologic surgeon is needed to get these children under the surgeon's care early and to overcome the reluctance of the parents to have anything done.

JOHN W. BRENNAN, M.D.

**Anthrax of the Kidney. Eight New Personal Observations (Anthrax del riñon. A propósito de 8 nuevas observaciones personales) RICARDO EXCULLI *Rev. argent. med.* 1945, 17, 7**

Observations of 12 patients with anthrax of the kidney are reported by the author. Four of them had been published previously.

Anthrax of the kidney is not such a rare condition as is generally assumed. As a rule, the condition has a tendency to spread toward the perirenal tissues and not toward the renal pelvis. In a relatively large percentage of cases a perirenal phlegmon results. Because of the fact that pyonephritis occurs only exceptionally in the course of anthrax, urinary findings are usually negative.

The past history may be suggestive of anthrax. The customary posterior location of the anthrax phlegmon produces a contracture of the perirenal muscles an intensive pain and immobilization and abnormal elevation of the involved side of the diaphragm. A pleural reaction may develop. In the acute film of the abdomen the absence of the shadow of the psoas muscle is conspicuous there may be a lordosis of the spinal column and a shadow produced by the perirenal mass. An excretory urogram may render great aid in the diagnosis. However it should be remembered that the pyelographic image of anthrax of the kidney may be similar to that of a febrile cancer of the same organ. Ascending pyelography is of lesser value.

The proper treatment consists of an enucleation of the involved area. A cure can be obtained in this manner in early periods of evolution of the condition. The conservative surgical procedure should be supplemented by the administration of antibiotics especially penicillin. Nephrectomy should be reserved for far advanced cases in which nearly the entire organ is involved in the suppurative process. JOSEPH K. NARAT M.D.

**Injury of the Vena Cava During Nephrectomy (Herfida de la vena cava durante la nefrectomía).** A. POTYVERT. *Arch. esp. urol.* 1948 5 66

Injury of the vena cava is one of the most serious accidents associated with renal surgery. Many outstanding surgeons have given especial consideration to this complication which demands immediate, quick action, clear judgment, and positive solution. The inundation of the entire abdominal cavity with blood is surprisingly rapid and can lead to considerable confusion with serious consequences before the source of the hemorrhage is identified.

Two cases are reported in which the vena cava was injured during the dissection of dense adhesions about the kidney and ureter. Digital tamponade quickly arrested the active bleeding and the injury to the vena cava was located after suction removal of the blood. Two forceps forming a "V" hooked off the injury and in one instance a free ligature sufficiently closed the defect, whereas in the other case continuous suture with a needle was required. On repair of the vein nephrectomy was completed. STEPHEN A. ZUCKMAN M.D.

**Surgical Intervention in Ureteral Calculi (La intervención quirúrgica en los cálculos del ureter).** PEDRO CURETTE. *Arch. esp. urol.* 1948 5 1

The author reports the removal of ureteral calculi by the lumbar approach (28 cases) the lateral lio-

pelvic approach (30 cases) and the middle hypogastric approach for low pelvic ureteral stone (14 cases) and by simultaneous removal of the kidney because of complicating kidney stones and kidney destruction (17 cases).

The ureteral stones varied from 0.5 to 3 cm. in diameter whereas in 1 instance a stone in the pelvic ureter measured 3 by 5 centimeters. Simple roentgenographs were sufficient in most instances to identify and locate the stones. In other cases cystoscopy and ureteral catheterization were necessary. The operations as a rule were simple except when considerable periureteritis existed, when the stone was in the lower kidney pole, or when the patient was unusually obese.

There was 1 immediate postoperative death attributed to intentional paralysis. 1 death occurred 2 years after operation and a third, 5 months from the date of surgery. The latter 2 deaths however followed bilateral renal lithiasis.

STEPHEN A. ZUCKMAN M.D.

**Transplantation of the Ureters into the Rectosigmoid and Cystectomy.** CHARLES C. HIGGINS. *Surg. Clin. N. America* 1948, 28 1209.

With the use of modern techniques and follow up methods it has been shown that the ureters and kidneys following ureteral transplantation into the rectosigmoid remain in a normal or fairly normal condition over a period of years. The author lists the following indications for this procedure:

**Exstrophy of the Bladder.** The procedure of choice for exstrophy is transplantation of the ureters followed by cystectomy. The operation should be performed during the first year for the following reasons: (1) Infants tolerate surgical procedures well (2) the operative mortality and morbidity are low (3) as years elapse recurring attacks of pyelonephritis result in irreparable kidney damage (4) it is probable that the organisms in the bowel of the infant are less virulent than in older children (5) early operation permits normal development from the physical and psychological standpoint (6) as the child grows older ureteral obstruction develops at the ureterocystic junction and results in dilatation of the ureters making the operation technically difficult and at times impossible.

**Carcinoma of the Bladder.** Cystectomy and transplantation of the ureters into the bowel are indicated in the following instances: (1) when extensive single or multiple infiltrating tumors are present (2) when the carcinoma at the base of the bladder encroaches upon the ureteral orifices or when the vesical sphincter and urethra are so involved that local treatment would destroy the ureteral orifices or cause incontinence, (3) when multiple recurring tumors develop so rapidly that they cannot be controlled by fulguration or irradiation (4) in the presence of early Grade 3 or Grade 4 neoplasms of the bladder. Neoplasms in this group may be treated by segmental resection which is preferable if the position of the tumor in the bladder favors the operation.

noted in the walls of the blood vessels that give rise to aneurysms elsewhere in the body among which arteriosclerosis and syphilis play a dominant role.

Most authors state that this lesion is asymptomatic. However a review of the symptoms recorded in published cases reveals that pain is more or less constant. In the author's 5 cases pain was a dominant factor. He believes that when a patient suffers from intractable pain in the kidney area, one should not hesitate to carry out operation for the purpose of performing renal sympathectomy and at the same time the renal artery and its branches should be explored for the presence of aneurysm.

The broken wreathlike shadow which is denser at its periphery is considered diagnostic. Brady and Hanten believe that when there is a defect in the calcified annular ring due to the connection between the aneurysm and the artery the differential diagnosis between aneurysm of the renal artery and other calcifications in and about the kidney can be positively made. Furthermore, laminograms taken in conjunction with an excretory urogram will reveal the shadow to be delineated in the same plane as the kidney. Unfortunately many aneurysms are not calcified and cast no shadow. Arteriography should be more commonly employed as a diagnostic method, particularly in patients presenting persistent renal pain in whom renal sympathectomy is contemplated. It gives valuable information concerning the distribution of the renal artery and its branches, and also may reveal the presence of aneurysm.

All authors agree that nephrectomy is the treatment of choice. Mathé emphasizes, however, that when the aneurysm involves one of the branches of the renal artery and the main branch is devoid of atheromatous changes, the aneurysmal sac can be resected without sacrificing the kidney. In the occasional case presenting a small fusiform aneurysm associated with other renal disease, such as pyelitis or hydronephrosis, the kidney lesion can be corrected without sacrificing the organ. The fibrosis that has taken place during healing can be relied on to reinforce the defect in the arterial wall.

ROBERT O. BEAULIER, M.D.

**Renal Tuberculosis in the Child (La tubercolosi renale nel bambino) O. OROSCO MARIO. *Urologia* 943, 5 562.**

Two thousand autopsies done on children at the Ospedale Maggiore at Milan, Italy disclose that about 3.76 per cent died of military tuberculosis. About half of these exhibited renal tuberculosis in the first year of life. The lesions were unilateral in 75 per cent. Unilateral lesions were more frequent from the fifth to the twelfth year and were located usually in the medullary and papillary regions. Vesical lesions were observed in a third of these cases but always after the tenth year. There was only 1 case of concurrent involvement of the testicle, epididymis and seminal vesicles in a boy 13 years of age.

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nosed clinically. This number when compared with the cases of congenital malformation and renal lithiasis, comprises 12.5 per cent of the whole and occupies third place. Surgical renal tuberculosis occurred more frequently in the female and predominantly in the left kidney. The lesion was always ulcerocavernous in character and in 1 case was associated with multiple renal calculi. In the latter case the tuberculous kidney was successfully removed; however the patient died of anuria before the stone in the other kidney could be removed. In the case of another child the parents refused operation. In the remaining 2 cases the kidney was successfully removed with disappearance of all symptoms.

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JAMES W. BRIDGES, M.D.

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The past history may be suggestive of anthrax. The customary posterior location of the perirenal phlegmon produces a contracture of the corresponding muscles, an intensive pain and immobilization and abnormal elevation of the involved side of the diaphragm. A pleural reaction may develop. In the scout film of the abdomen the absence of the shadow of the psoas muscle is conspicuous; there may be a lordosis of the spinal column and a shadow produced by the perirenal mass. An excretory urogram may render great aid in the diagnosis. However, it should be remembered that the pyelographic image of anthrax of the kidney may be similar to that of a febrile cancer of the same organ. Ascending pyelography is of lesser value.

The proper treatment consists of an excision of the involved area. A cure can be obtained in this manner in early periods of evolution of the condition. The conservative surgical procedure should be supplemented by the administration of antibiotics, especially penicillin. Nephrectomy should be reserved for far advanced cases in which nearly the entire organ is involved in the suppurative process.

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STEPHEN A. ZIEGLER, M.D.

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The author reports the removal of ureteral calculi by the lumbar approach (23 cases), the lateral ilio-

pelvic approach (30 cases) and the middle hypogastric approach for low pelvic ureteral stone (14 cases) and by simultaneous removal of the kidney because of complicating kidney stones and kidney destruction (15 cases).

The ureteral stones varied from 0.5 to 3 cm in diameter whereas in 1 instance a stone in the pelvic ureter measured 3 by 5 centimeters. Simple roentgenographs were sufficient in most instances to identify and locate the stones. In other cases cystoscopy and ureteral catheterization were necessary. The operations as a rule were simple except when considerable periureteritis existed when the stone was in the lower kidney pole or when the patient was unusually obese.

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**Epispadias** When the defect is so extensive that plastic operations fail and incontinence persists, transplantation of the ureters into the bowel may be desirable.

**Tuberculous cystitis** The presence of intolerable bladder symptoms after nephrectomy in unilateral renal tuberculous may be an indication for a ureteral transplant if the ureter on the normal side shows dilatation with a coexisting early hydronephrosis.

**Interstitial cystitis** If conservative treatment is of no avail transplantation of the ureters into the rectosigmoid may be justified.

**Incontinence following transurethral resection** If the incontinence is permanent the patient should not be forced to wear a receptacleasmuch as relief can be afforded by transplantation of the ureters into the bowel.

**Uterovaginal fistula.** In patients in whom the defect is so extensive that it involves the bladder sphincter and urethra, and incontinence remains even after closure transplantation of the ureters may result in complete relief.

In infants the operation for transplantation of the ureters and cystectomy is performed in two stages. The right ureter is first implanted into the bowel 10 days later the left ureter is transplanted into the rectosigmoid and the exstrophic bladder is removed.

In adults, the general condition of the patient, the presence or absence of renal infection, and the caliber of the ureters influence the decision as to whether both ureters should be transplanted simultaneously or whether unilateral transplantation is preferable. Generally the author prefers to transplant the right ureter in one stage and then 7 to 10 days later he transplants the left ureter and performs the cystectomy.

The technique of the operation is described in detail, and the exact preoperative and postoperative care and orders are outlined, as the author states that no stage of the operation is more important than the initial preparation of the patient. The author concludes that adequate preoperative preparation, postoperative care, and the refinements in surgical technique have reduced the mortality from this procedure to a point where there should be no hesitancy in recommending the operation in selected cases.

The patients are comfortable, have complete control of the urine and may lead a normal life.

Dilatation of the ureters, hydronephrosis, and renal sepsis may be avoided by careful attention to the technical details of the operation.

Radical operation is recommended for those cases of carcinoma of the bladder in which conservative treatment carries a high morbidity and little prospect of cure.

ROBERT O. BRADLEY, M.D.

Surgery of Upper Urinary Tract. WILLIAM J. BAKER  
J. Urol. Balt. 94:3, 60: 97

Modern urology emphasizes the reasonable salvage of the urinary tract whenever it is possible. Conservative renal surgery is illustrated in the plastic operations on the renal pelvis and its junction with

the ureter to correct hydronephrosis. An attempt to provide adequate renal drainage is always justified, if the age of the patient and the condition of the renal parenchyma fulfill their part of the equation. It is very difficult, however, to predict how much repair of renal tissue will take place or how much function will return after the relief of obstruction has been accomplished. The end results of bilateral pyeloplasty are at times quite gratifying. The author's second case demonstrated that bilateral plastic operations on the ureteropelvic junctions in a 52 year old woman conserved renal tissue and would no doubt prolong her life for many years.

The mediocre results of conservatism in the management of hydronephrosis associated with aberrant renal vessels was discussed by the author. This was especially noted in those instances in which the vessels were cut and no corrective procedure was done at the ureteropelvic junction. A pyeloplasty as well as the severance of obstructing vessels and bands at the ureteropelvic junction is necessary for the best postoperative results.

Conservative management of unilateral ureterohydronephrosis requires consideration of the degree of destruction of the renal tissue, the duration of the obstruction, the cause of the obstruction, the age of the patient, and the existing blood pressure. Experimental work has shown that an obstruction in the ureter that has existed over 90 days produces irreversible renal damage, and a proper renal counterbalance cannot be expected after the obstruction has been relieved. One of the author's cases illustrated that a pyeloplasty of a long-standing unilateral advanced hydronephrosis associated with hypertension, even in a 36 year old woman, was contraindicated. In this case, a nephrectomy proved to be a conservative procedure. Ormand directed attention to the many nephrectomies following unsuccessful plastic operations for hydronephrosis, while Moore and Walters stated that unsatisfactory results can be expected in 30 per cent of plastic operations on the kidney pelvis.

Better results are to be expected if ureteral splitting and nephrostomy drainage can be prolonged from 3 to 6 weeks. Many patients obtain symptomatic relief after a plastic operation at the ureteropelvic junction without much change in the anatomical contour of the pelvis. The symptomatic relief may come from the nephroureterolysis while the same procedure disturbs the nerve supply enough to prevent return of normal or near normal anatomic form.

A stone-bearing calyx or a hydrocalyx is the principal indication for partial renal resection or calyctomy. Many authors have reported series of patients who have had successful partial resection of the kidney heminephrectomy for disease of one calyx or of the pelvis of a double kidney. Heminephrectomy is usually easy when there is a double kidney because the blood supply lends itself to removal of the half of the kidney bearing the disease. The upper half of a double kidney is usually the smaller part of the renal mass and the site of the disease.

Conservatism should play a part in the management of many large bilateral renal calculi. The symptoms condition of the kidneys and the age of the patient should help to decide whether these calculi should be surgically removed.

One of the greatest problems in conservative renal surgery concerns the procedure to be followed when the kidney and ureter have been obstructed with moderate sized or large calculi longer than 3 months. The removal of a long standing calculus obstruction at the ureteropelvic junction or the juxtavesical portion of the ureter will many times be followed by little or no return of anatomical form, and a symptom-producing dilated infected ureter and kidney remain. Strictures form very rapidly in these ureteral regions in spite of postoperative dilatations. Nephroureterectomy is frequently necessary in many instances in order to obtain a symptom free patient.

The author presented the case of a patient in whom a ureteral stone had been removed through a ureterotomy. Complete obliteration of the left ureter was observed 2 years after operation. A silent autonephrectomy had developed that was apparently caused by the reaction of the calculus in the lower ureter.

Congenital strictures may present a surgical problem. In a case of stricture of the upper third of the ureter along with hydronephrosis, a left ureteroplasty and nephrostomy with catheter drainage of 6 weeks duration justified this type of conservative surgery.

Conservative management is often indicated in the treatment of traumatic kidneys. Exploratory operations have been advocated if hematuria is present longer than 24 hours. The clinical picture usually suggests the necessity for operation upon the injured kidney.

Baker used conservative treatment on 8 patients with unilateral pyogenic kidneys. In a boy 11 years of age, he was able to cauterize the pyogenic area from the renal parenchyma. In the second case, a patient 45 years of age recovered his health following the removal of a walnut-sized renal carbuncle.

A complete nephroureterectomy is the procedure used for pedunculated renal tumors. In one of the author's cases however he was able to remove a pedunculated papilloma 6 inches in length with the electric cutting needle. The patient's recovery was uneventful. This is not the method of choice however in the treatment of all tumors of the ureter.

In summary the author stated that one should sincerely try to conserve renal tissue, but one cannot always prophesy the degree of success of his efforts. Failures and unfavorable results following surgery may be due to poor understanding of the neuromuscular physiology of the kidney and ureter. Improper estimation of final renal counterbalance may also account for many of the poor results of conservative renal surgery that have to be followed by a subsequent nephrectomy. The added experience of the surgeon and the use of the antibiotics should render conservative renal operations more successful.

CORRAD A. KUEHN, M.D.

## BLADDER, URETHRA, AND PENIS

Deformities of the Male Urethra. SIR ARCHIBALD McINDOE. *Brit J Plast Surg.*, 1948, 1: 29.

The author discusses deformities of the male urethra from the viewpoint of a plastic surgeon. The general principles he stresses are:

1. Anatomical (a) It must be of adequate caliber (b) it must not contract to produce a stricture (c) it must be sufficiently long and elastic (d) the lining must not be hair bearing and (e) there should be a good cosmetic result.

2. Physiological. Throughout the planning of repair the sexual function should be also taken into consideration.

3. Surgical. It is necessary to direct the urinary stream and usually external urethrostomy is advisable. Hematoma and infection should be guarded against by the use of accurate hemostasis, fine instruments and atraumatic sutures.

The author then discusses in detail the use of the above principles in the repair of 58 urethras comprising this report. The patients had penile injury (6) penile amputation (3) congenital short urethra (2) epispadias (6) and hypospadias (35).

JOHN A. LOFF, M.D.

The Value of Immediate Urethrography and Immediate Reconstruction of the Urethra Over a Support in Traumatic Ruptures of the Membranaceous and Perineal Urethra (Valeur de l'urographie immédiate et de la réfection immédiate de l'urètre sur tuteur au cours des ruptures traumatiques de l'urètre membraneux et périméale). L. SABADINI. *J. chir., Par.* 1948, 64: 420.

Only urethrography is able to furnish information concerning the exact location of a rupture of the urethra and the presence of periurethral injuries, but in the presence of a trauma of the urethra, urethrography has been dogmatically contraindicated because of the danger of embolism or spread of the infection by the contrast medium.

The author employed urethrography in 70 patients with recent ruptures of the membranaceous or prostatic portion of the urethra without untoward effects. He employed a 40 per cent solution of lipiodol 1 part, and 10 per cent oil, 2 parts as the contrast medium. The mixture is not only sterile but bactericidal.

Fractures of the pelvis without a lesion of the urethra may provoke a retention of the urine. Negative findings of urethrography in such instances contraindicate surgical intervention. From the medico-legal point of view visualization of a lesion of the urethra on the x ray film is of great value. More over clinical examination alone is not enough to detect penurethral lesions or to indicate their intensity. Demonstration of participation of the middle aponeurosis in certain perineal ruptures by urethrography is extremely valuable. In undergoing preliminary cystostomy the author derives great benefit from ascending and retrograde urethrography. No

Infection, embolism or the slightest elevation of temperature has been observed by the author after the employment of this procedure.

The time allowed to lapse between the preliminary cystostomy and urethral repair depends on the site of the injury.

For the repair of a perineobulbar rupture a vertical scrotoperineal incision is made. The hematoma resulting from the tear of the superficial perineal spongioma is removed. The bulbocavernosus muscles are always found sectioned in a transverse direction. A longitudinal incision is made through these muscles and the corpora spongiosa. All devitalized tissues must be removed. The urethra is reconstructed over a rubber tube one end of which is pulled out through the cystostomy with a retrograde catheter. In some instances it may be easier to bring out through the perineal wound, by means of a curved clamp a catheter introduced through the cystostomy. The other end of the tube is brought out through the meatus.

For the repair of a rupture of the membranaceous portion of the urethra, a scrotoperineal vertical incision is made and the retromembranoprosthetic space is exposed. The pelvic hematoma is removed and the prostatic space is exposed. The torn urethra is trimmed and a longitudinal incision is made through the bulbar urethra to provide a better exposure. No debris should be left as it is apt to produce stenosis. The urethra is reconstructed over a rubber tube. The anobulbar raphe is also reconstructed by uniting the bulb with the anterior wall of the anorectum. After the repair of the membranaceous portion, the bulbar urethra is reconstructed with catgut over a rubber tube. No drainage is employed. The author uses a soft rubber tube 30 cm. long with a gauge of from 18 to 20, according to the patient's age.

The author advocates repair of the urethra at the earliest date after the injury preceded by urethrogram. If the facilities for the repair are not immediately available, vesical puncture or preferably cystostomy should be done.

After the operation the urethral portion of the rubber tube is pulled out, washed with ether oil, and pulled back. No antiseptic solutions are employed for irrigation of the tubing or for injections between the tube and the urethra. The tube is left in place from 3 to 4 weeks, or more to prevent scar formation. Penicillin is employed routinely. After 3 or 4 weeks the tube is removed at the same time as the vesical drain and is replaced by a Nelaton catheter. Every second day a diathermy treatment is given to soften the scar. As a rule from 10 to 15 treatments are given. Disruption of the urethra is of no clinical importance because it is followed by complete restitution.

JOSEPH K. NARA, M.D.

Transurethral Resection in Childhood. JONES L. EMMETT and HENRY F. HELLMAN. *J. Urol.*, Balt., 64:8, 60: 463

Urinary stasis, the cause of which is below the level of the nreteropelvic junction, continues to be one of

the most difficult problems in pediatric urology. All too often the etiology and pathogenesis of the condition is obscure so that the therapeutic problem is poorly defined. Even when the causative factor is clear-cut, therapeutics may be most difficult to carry out.

The treatment of a few well defined and rather rare obstructive conditions which occur at the ureterovesical junction such as ureterocoele and congenital stenosis, is not considered, but the authors discuss the therapeutic efforts to correct urinary stasis (below the level of the ureteropelvic junction) which are directed toward infravesical conditions (affecting the vesical neck, prostate, and urethra).

The authors have selected all patients at the Mayo Clinic less than 30 years of age on whom a transurethral operation has been done for abnormal conditions at the vesical neck or in the prostatic urethra from October 1, 1941 through December 31, 1945. They did not include 5 patients in this age group who underwent resection because of a neurogenic bladder caused by transverse myelitis of traumatic, inflammatory or neoplastic origin. The study concerns 49 patients, of whom 34 were male and 15 female. By means of re-examination of the patients and follow up letters recent data concerning the condition of 40 of the 49 were obtained. For the remaining 9 patients the record of the patients at the time of dismissal were used in evaluating the results of the operations.

Urinary stasis in infants and children in which the causative lesion is below the level of the ureteropelvic junction may often be relieved by transurethral resection of the vesical neck.

Young people who require transurethral resection may be divided into two groups: (1) those who have vesical dysfunction which results from myelodysplasia and spina bifida, and (2) those who have congenital obstruction of the vesical neck.

There are two problems to consider in the group of patients with myelodysplasia and spina bifida: (1) relief of obstruction of the vesical neck and elimination of residual urine (which is essentially the same problem as in cases in which cord bladder results from acquired lesions of the spinal cord) and (2) correction of an incompetent external urethral sphincter. Because of the inability to combat the latter problem, normal vesical function can be re-established in only about 1 of 3 patients of this group.

The patients with congenital obstruction of the vesical neck respond to treatment with transurethral resection in a much more satisfactory manner. In more than 2 of 3 patients normal vesical function can be restored. The ultimate course of these patients depends on the amount of renal damage present. Early diagnosis is therefore important. In the authors' patients, no congenital urethral valves were encountered. The type of obstruction encountered consisted of lobar hypertrophies, bars, contractures of the vesical neck hyperplasia of the "internal sphincter" and redundant tissue at the vesical neck and normal-appearing vesical necks.

## GENITAL ORGANS

Is the Roentgenological Appearance of the Spine and the Skeleton Always Diagnostic of Osseous Metastases from Cancer of the Prostate, and from Other Cancers? (L'aspect radiologique du rachis, et du squelette, permet-il de conclure toujours à l'existence de métastases osseuses dans le cancer de la prostate, et dans les autres cancers?) M. GEORGES KUNES. *Mém Acad chir. Par.*, 1948 74 237

Fey presented to the Radiological Society on April 30, 1947 the case of a patient who had ivoryization of the body of the second lumbar vertebra. The type of lesion in the bone permitted him to make a diagnosis of vertebral metastasis from a previously undiagnosed cancer of the prostate. A roentgenogram taken 4 months later under the effect of diethylstilbestrol showed the body of the second lumbar vertebra to be clear with a return of its osseous structure.

M. Louis Michon reported the case of a man 65 years of age who had been treated by diethylstilbestrol and castration. Radium was applied from September 22 to 26, 1942. This treatment was followed by intense lumbosacral pain that was not relieved by diethylstilbestrol therapy. On August 19, 1945 a bilateral castration was done with total relief of pain within several hours following the operation.

The author described a patient who had been treated with diethylstilbestrol and glonoxines of Rubens-Duval. The patient's urine was clear and he had two or three nocturnal micturitions. Episodes of lumbar pain occurred from time to time. The author described in detail the roentgen findings during this period from August 13, 1945 when the first examination was made until the last roentgenograms were taken on December 27, 1947. The first pictures showed "ivoryization" of the entire lumbar column, the vertebra L-1 to L-5 inclusive having a cloudy pagetoid appearance, along with the osseous pelvis and the superior extremities of both femurs. The second roentgen examination November 10, 1947 showed a similar pagetoid appearance. There was no deformation of the bodies of the vertebrae or the vertebral discs. The third examination made April 19, 1947 showed about the same condition. The author thought there was an osteoporosis of the lumbar column, the pelvis, and the femurs associated with a cellular diathesis of cottonlike appearance. The fourth and last examination made on December 27, 1947 showed the pagetoid appearance not only in the lumbar column but in the entire vertebral column, the entire pelvis, the femurs, the left tibia and the clavicles with profound modification in the structure of these bones. This modification was particularly marked in the pelvis and the spine. The lesions probably involved the entire skeleton, but without deformation, however of the vertebral bodies or the vertebral discs.

From a roentgenological point of view here was a case in which a diagnosis of cancer of the prostate with neoplastic metastases to the entire lumbar column, the osseous pelvis, and the superior extrem-

ity of both femurs, was made in December, 1947. The roentgenological interpretation of the film was given as a more or less pagetoid appearance of the bones with osteoporosis associated with a cellular diathesis. These pictures do not exclude the possibility of osseous metastases absolutely in fact they suggest at least the possibility of these metastases. While vertebral, pelvic, and generalized metastases are frequently found in cancer of the prostate it is the roentgen interpretation of these bone lesions that suggests metastases from silent or semisilent cancer of the prostate.

The author divided the localization of osseous metastases of cancer of the prostate in the spine, and especially in the lumbosacral spine, into three forms:

1. The osteoporotic and osteoclastic form shown by involvement of one or several vertebral bodies. The spreading involvement is shown by progressive bone destruction by the metastases. The intervertebral disc is not involved, however.

2. The osteoplastic form is more frequently encountered than the osteoporotic and osteoclastic. This form consists of a double process: one of osseous condensation and the other of proliferation of new bone. This results in osseous deformation, rarefaction and osseous destruction with decalcification. The two processes are manifested by clouding and marbling suggestive again of the appearance of the bone in Paget's disease.

3. The third form is that of condensation. It is characterized by calcification of the vertebral body with metallike appearance or ivoryization of the vertebrae. The observer is surprised by the absolute opacity of the body of the vertebrae, there being no trace of the usual osseous structure.

There is no typical roentgenological or graphic appearance of the vertebrae that can be considered to be characteristic of cancer of the vertebrae, and especially that due to cancer of the prostate. Kunes draws attention to the fact that the same osteoporotic and osteoclastic lesions may be due to Kummel-Verneuil decalcifications following fractures, trauma to the spine, spondylolithesis, epiphyseitis and certain forms of Pott's disease along with various generalized osseous infections.

In the condensation form the dark or black vertebra, or ivorylike vertebra shows progressive evolution of defense and hyperosteo-genesis reacting from diverse causes. Vertebral ivoryization is found in other osteopathies as well.

In short, one is able to encounter diseases of the hemopoietic system or reticuloendothelial system: myeloid leucemia, Sternberg-Hodgkin's disease, and other diseases of the same origin that present roentgen findings more or less frequently found in the diffuse type of Paget's disease. Of the three forms of roentgenological spinal metastases the intermediate or transitional forms are hard to classify.

The author stated that from his study he concludes that there was no characteristic picture of spinal metastases, for many diseases give the same roentgenological picture. This makes the differential

... of metastases very difficult and

... believes that the roentgenological findings are sometimes been interpreted as being characteristic of the absence of metastases when they are bone changes secondary to disturbances of calcium metabolism and especially to modifications in the phosphatase rate in old men who most often are affected with cancer of the prostate.

The elevation of the phosphatase is also observed in Paget's disease, Recklinghausen's disease, and in osseous rickets; therefore it is an error to use the term "metastases" with regard to bone changes in the presence of a prostatic neoplasm as they are simple changes due to modification of the phosphatase rate.

Kuess demanded that all of his colleagues make biopsies at autopsy and anatomical pathological examination of the vertebrae which they have recognized roentgenologically as being the site of cancerous metastases.

In the ensuing discussion Wolfrohm stated that he agreed with the author that without biopsies, one is not able to make a definite diagnosis of metastases from cancer of the prostate. He further observed that some testicles have been removed with only temporary relief of pain. One is not able, he stated, to establish a relationship between osseous alteration and the production of acid phosphatase in cancer of the prostate. The phosphatase is not able to construct or destroy bone, for this role is delegated to other hormones.

In Paget's disease presenting osseous tumors, non-prostatic in origin, the acid phosphatase is not increased but the alkaline phosphatase is. The amount of phosphatase reveals a paradox. The phosphatase is normal in patients with gross metastases from cancer of the prostate, yet the prostate may be filled with acid phosphatase. Wolfrohm suggested that it would be advisable to follow the clinical course of the patient by repeated acid and alkaline phosphatase determinations of the blood; however, this would be difficult because of the burden placed upon hospital personnel and the expense to the patient of tests that would only assist in diagnosis and not in therapy. He regretted that it was not always possible to obtain biopsies from the suspected area.

confirmed the existence of osseous lesions; a great number were found in the skin and liver and all were discovered to be from the cancer of the breast.

In concluding the discussion, the author confirmed the suggestion of Wolfrohm that biopsies and autopsies be obtained that would permit recognition or deny the metastatic character of the osseous alteration shown by roentgenography. He suggested that roentgenograms be taken of the vertebral column after autopsy, or a biopsy made if possible, and anatomic and pathologic examination of the lesions be made. Then a comparison of the known metastases with the evidence obtained by roentgenography in doubtful cases should be made in order to have more information about the roentgenological appearance in the living patient. It is easy, the author stated, to demand biopsies and autopsies, but in practice it is quite difficult to make these examinations. The prognosis depends upon the therapeutic decision; above all, and this in turn very often depends upon the roentgenologic interpretation of the metastatic or other bone lesions.

The author cited a case of Cosasescu of Bucharest. This case was that of a woman having osseous lesions that could either be due to hyperparathyroidism or be metastases from epithelioma of the breast. The roentgen findings were considered to be the same in both diseases, and it was not possible to decide the diagnosis roentgenologically. The author removed the enlargement of the thyroid gland on the right side and thus removed the cause of the hyperparathyroidism. He noted postoperative improvement in the condition of the bone, and deduced from this finding that the patient had a hyperparathyroidism rather than metastases from cancer of the breast. This patient illustrated the author's view that roentgen examination alone is not sufficient to decide the proper diagnosis, the prognosis, and the best therapeutic approach.

CONRAD A. KUEHN, M.D.

Cryptorchidism. LLOYD G. LEWIS, J. Urol. Balt., 94:5, 60-34:5.

vided no anatomical or pathological condition prevents transit through the inguinal canal.

Anterior pituitarylike hormones will advance puberty in boys nearing that phase of their normal development. The use of gonadotropic hormones will hasten descent of the testis only in those patients whose testes would normally descend at puberty.

The use of hormones at or shortly before puberty may prevent unnecessary surgery.

If the testis does not descend after the use of 50,000 rat units of anterior pituitarylike substance in a dosage of 500 rat units twice or three times a week, surgery is indicated without delay.

The Torek operation or the traction suture method of orchiopexy apparently gives the best anatomical results.

Spermatogenesis following orchiopexy depends upon preservation of the internal spermatic vessels.

Division of the sheath of the internal spermatic vessels and straightening of their course under vision to allow placement of the testis in the scrotum deserves our serious consideration.

JOHN A. LOEF, M.D.

**Malignant Tumors of the Testes** (Tumores malignos del testículo) ALBERTO RAHAUSEN *Bol. Soc. cir. Chile*, 1947, 25, 203.

Of 73 malignant tumors of the testes observed by the author, 74 per cent were seminomas.

The author has observed that seminomas are radiosensitive and that treatment can be given in such a manner that it does not harm the organism. It is essential to irradiate the regions in which glandular metastases are most frequently encountered.

In 45.2 per cent of the author's material the tumor was found in the third decade of life, in 30 per cent it was noticed in the second decade and in 19.1 per cent in the fourth decade. The oldest patient was 57 years and the youngest 2 years and 8 months of age. In 54.8 per cent of the patients the tumor was located in the right, and in 45.2 per cent in the left testicle.

In 2 of 6 patients with undescended testicles the tumor was discovered in the testis which was in its normal position; in 1 instance the tumor affected the ectopic organ; in 2 patients the tumor was located in organs which had been brought into the scrotum a few years previously by means of an operation; finally, in 1 case the tumor developed in a testis which slipped into the abdomen after a herniorrhaphy. In only 6.8 per cent of the entire material was a seminoma located in an ectopic organ. In 35 per cent of the cases a trauma was recorded in the past history but the author does not attribute great importance to this factor because in many instances only a minor injury preceded the development of the tumor and the interval between the trauma and the discovery of the tumor was rather long.

The period of evolution of a seminoma is relatively short. Increase in size of the affected organ is usually the first sign. The pain has no characteristic fea-

tures. At the time of examination no metastases were detectable in 30 per cent of the cases.

The most frequent sites of metastases are the ilioinguinal and preaortic regions of the abdomen, also the mediastinum and the left supraclavicular region.

The author prefers an aspiration biopsy to obtaining a specimen by means of an incision.

As to the diagnostic value of the Aschheim-Zondek reaction, a positive finding is suggestive of a malignant tumor; if a positive reaction is obtained after extirpation of the tumor, the existence of a metastasis should be suspected. On the other hand, a negative reaction does not exclude the existence of a seminoma.

After the establishment of the diagnosis of a seminoma, from 1,000 to 1,500 roentgens should be applied to the involved organ. After this preliminary irradiation the organ should be removed and the common sites of glandular metastases should be subjected to x-ray therapy.

Of 60 patients treated by the author in this manner, 26.6 per cent were cured.

JOSEPH K. NARAT, M.D.

## MISCELLANEOUS

**Genitourinary Injuries.** JOHN B. WEAR, *J. Urol.* Balt., 1948, 60, 380.

A discussion of trauma to the genitourinary tract cannot follow a fixed pattern of general statements because the cause and extent of the injury must always be considered. It is difficult for the surgeon to determine the extent of the injury. In civil life the extent of the injury is usually determined by how people in that community work and play. In military life the same types of injuries may occur but, in addition, penetrating wounds from missiles of all sorts as well as an extreme degree of tissue loss may involve more than one organ.

The kidney is not often injured in either civil or military life. Because of its location it is well protected from all types of injury and the same position makes it possible for the kidney to recover without surgery in most cases. The mere fact that blood appears in the urine and a mass develops in the side does not call for immediate operation. Grave injury may occur without hematuria and without a lumbar mass, but pain is usually a predominant symptom in these cases. In establishing the extent of the renal injury the retrograde pyelogram, the exploratory operation or clinical judgment based upon observation with the intravenous urogram may or may not give information that is desired for the proper management of the case.

Case 1 was chosen by the author to suggest that even though the patient had an apparently mild injury without loss of normal contour of the kidney, examination demonstrated that 3 months later the function of the injured kidney had been so reduced that only a faint trace of diodrast was seen in the 20 minute film.

In Case 3 the patient had a severe injury to the kidney but recovered from the trauma without surgery.

Case 3 was that of an 18 year old sailor who fell while jumping over a fence. He was kept under observation because of hematuria and a large tender mass developed in the abdomen. The urine was free from blood in 5 days, but he developed a secondary hemorrhage on the twelfth day which necessitated an exploratory operation. This case demonstrated the value of bed rest in conservative treatment. Secondary hemorrhage always suggests the possibility of renal injury and when it does occur it is usually serious and demands immediate surgical treatment.

An 18 year old boy fell and struck the right side of the abdomen on a post. Subsequent examination revealed a large hydronephrosis containing 450 c.c. of urine. At the time of injury the hydronephrotic sac had ruptured. Recovery was uneventful following nephrectomy.

In the last case a 12 year old boy suffered an injury in which the ureter had been torn from the pelvis. On operation, it was found that the kidney was surrounded by dense adhesions. Hydronephrotic kidneys are prone to injury and early operation is usually indicated.

The author presented 5 cases of bladder and urethral injuries. The treatment in this type of case is usually clearly indicated. The results depend upon the extent of the injury, the first treatment given and the time required for definitive treatment. The drainage and diversion of the urinary stream is of primary consideration. When associated organs are injured their repair takes precedence over the urinary tract injury after diversion of the urinary stream has been established.

In Case 6 a marine was injured by a machine gun bullet entering his right thigh. The bullet had traversed the prostate near the bladder neck. The treatment in this case consisted of retrograde dilatation of the urethra through the previously established cystostomy. The balloon of the catheter was held in place against the internal vesical orifice by light traction. The patient was able to void normally 3 weeks later when the catheter was removed.

Case 7 was that of a naval officer who had suffered a 1 inch laceration of the bladder wall. The treatment in this case was a suprapubic cystostomy followed by a subsequent urethral dilatation.

Case 8 was that of a sailor who had suffered multiple pelvic fractures. A suprapubic cystostomy revealed a laceration of the right side of the bladder. The treatment consisted of evacuation of a considerable quantity of blood and urine and maintaining the catheter drainage.

Case 9 was that of a man who was hospitalized several months following a rifle shot that entered the abdomen over the bladder with its point of exit through the right buttock. Urine drained from this tract. The first operative procedures were laparotomy, indwelling catheter and right nephrectomy. The bullet had severed the right ureter as it left the bladder. A suprapubic cystostomy revealed that the right bladder wall was adherent to the pelvic bone. This area of the bladder was resected. The bladder was closed and the adherent tissue was then removed with a peritoneal elevator.

The final case was that of a marine who had been shot in the perineum by a rifle bullet. Colostomy and suprapubic cystostomy were done in the forward area. Four months later the urethra was exposed and found to be completely severed just in front of the urogenital diaphragm. The scar tissue was cut away and the ends anastomosed over a urethral catheter. Recovery was uneventful. Two weeks later the colostomy was closed, and one week after that the suprapubic tube was removed. He was unable to void, but he was instructed to have periodic urethral dilatations. This case illustrated the management of a combined injury to the bladder and bowel.

The author summarizes the paper as follows: (1) even moderate renal trauma may cause loss of function, and repeated intravenous programs several months after the injury are desirable; (2) after severe injury of the kidney it will frequently recover without surgery and without evidence of permanent damage, but secondary hemorrhage from too early ambulation requires immediate surgery; (3) lack of blood in the urine does not necessarily mean that the kidney is intact, and evidence of pelvic injury demands early surgery; (4) late surgery in kidney wounds usually results in nephrectomy; (5) in bladder wounds, immediate drainage is imperative; (6) when associated structures are injured, their care has precedence after bladder drainage; (7) late urethral repair means morbidity and difficult surgery.

CORRAD A. KUTNER, M.D.

# SURGERY OF THE BONES, JOINTS, MUSCLES, TENDONS

## CONDITIONS OF THE BONES, JOINTS, MUSCLES TENDONS ETC.

**Meniscus Malformations as the Cause of Snapping of the Knee Joint** (*Meniscusmalbildungen als eine Ursache des Kniegelenkschnellens*) **ALFRED SOX**  
*Klin. Wochenschr.* Berl. 1948, 15 218

Meniscus malformations occur in two forms as a disc which represents an ontogenetically and phylogenetically older stage and as a ganglion which is a cystically degenerated meniscus. Such menisci cannot fulfill their normal function as mobile cartilaginous sockets, but cause the phenomenon of knee joint snapping during flexion and extension of the joint. The author reports the case of 11 persons who were operated upon between the ages of 15 and 38 years.

The malformations were found only in the lateral meniscus even in 3 patients in whom both knees were involved. Although the defects were already present at birth they did not cause disturbances during childhood except in cases in which the size or form of the meniscus greatly altered its relations with the condyle. This was the finding in a child of 18 months. Usually the disturbances appeared in youth or at the latest about the time of the end of growth in cases of disc meniscus and at a later age in cases of ganglion meniscus the cysts of which developed gradually under the stimulation of mechanical damage. Subjective symptoms predominated over motility disturbances in cases of ganglion, while disc meniscus caused a painless impediment to movement. The first disturbances were often reported in connection with an injury although trauma has no etiologic significance in the disorder. It can influence the appearance of symptoms and it may play a part in the origin of the cysts.

The lining of the cysts consists of modified connective tissue cells which present a morphologic resemblance to those of the synovial accessory organs older cysts with a thin internal wall and fibrous thickened capsule show a similarity in structure with the joint capsule.

In the first 4 patients the extirpated menisci presented the form of a tough, thick plate which in 1 patient, was practically square and had a diameter of 4 to 5 cm. The plates were 8 mm. thick and were flat except for some knobby swellings on their borders. These menisci were incapable of playing their role of a mechanical sliding bed and produced a characteristic snapping of the knee joint during flexion when the angle of 160 degrees was being passed there was first an arrest then a sudden acceleration of the movement while the leg rotated outward or inward and then rotated back and completed the movement without further disturbance. During extension the same phenomenon occurred but was stronger. Simultaneously a popping noise was

heard and a swelling was observed at the lateral articular space. The jerking could be avoided when traction was exercised on the leg during flexion and extension.

Among the 7 patients with meniscus ganglion, there was only 1 in whom knee joint snapping could be demonstrated regularly and 1 in whom it occurred occasionally.

Treatment consists of extirpation of the lateral meniscus. In cases of cystic degeneration which often gives the impression of the presence of a single cyst and offers the temptation of puncture the ganglion is usually polycystic and puncture would fail because it could not reach all the cavities.

RICHARD KEMZL, M.D.

## SURGERY OF THE BONES, JOINTS MUSCLES TENDONS, ETC.

**Tendon Plastic for the Surgical Treatment of Dislocation of the Head of the Radius** (*Proposta di plastica tendinea per la cura cruenta delle lussazioni della testa del radio*) **VINCENZO LATIUSCELLA**  
*Ann. Ital. Chir.*, 1948 25 157

The author proposes a new type of surgical treatment for a dislocated head of the radius in which the tendon of the brachialis anticus is used to make a new annular ligament around the head of the radius once the dislocation is reduced.

A curved incision is used starting on the lateral aspect of the elbow about 4 or 5 cm. above the lateral condyle of the humerus and descending to about 3 or 4 cm. below the head of the radius. The incision is then curved upward and medially to the base of the olecranon. The skin and subcutaneous tissues are then reflected upward and the antibrachial fascia is exposed.

The head of the radius is exposed between the brachioradialis and the brachialis anticus. The insertion of the biceps tendon is retracted medially and the brachialis anticus is isolated. The radial half of the tendon is slit longitudinally leaving it attached to its insertion. It is then drawn around the neck of the radius under the muscles and is attached subperiosteally to the ulna on the posterior aspect.

Postoperative immobilization is attained by the use of a cast. This is removed after 2 weeks.

CARLO SCORNI, M.D.

**Results of Open Reduction of True Congenital Luxation of the Hip.** **JACQUES LÉVEY**  
*J. Bone Surg.*, 1948, 30-A 875

In dislocation there is interposition of the soft tissues between the head of the femur and acetabulum. On the other hand in subluxation interposition of soft tissues never exists. In true luxation established by arthrography, interposition of the soft tissues makes reduction impossible without open operation.



In Case 2 the patient had a severe injury to the kidney but recovered from the trauma without surgery.

Case 3 was that of an 18 year old sailor who fell while jumping over a fence. He was kept under observation because of hematuria, and a large tender mass developed in the abdomen. The urine was free from blood in 3 days, but he developed a secondary hemorrhage on the twelfth day which necessitated an exploratory operation. This case demonstrated the value of bed rest in conservative treatment. Secondary hemorrhage always suggests the possibility of renal injury and when it does occur it is usually serious and demands immediate surgical treatment.

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CONRAD A. KUTNER, M.D.

results of intra articular and juxta articular arthrodesis with bone grafting may be made. From the obtained bony union and 30 per cent, fibrous union. In the earlier series of 53 cases of intra articular arthrodesis with bone grafting about 85 per cent of the patients had bony union and 5 per cent fibrous union. The patients with fibrous ankylosis tend to do well on the whole but their hips are subject to strain, bony union would be more gratifying. It should be noted that the age grouping of the two series was fairly comparable.

The mortality rate is far from discrediting to the earlier operations. Only 1 patient of the 53 died. The average period in bed was 11.4 weeks but the author believes this can be cut to 10 weeks without adverse effects.

Bony ankylosis did not occur any earlier in the nailed group than in the earlier group. Simple trans-articular nailing without resection of sclerotic bone required a longer period for bony union than either the combined nailing or the intra articular arthrodesis with bone grafting.

While the nailing procedure was undertaken to reduce bed rest and was followed, in about 3 weeks by the simple transarticular nailing, the advantage and fractured nails are considered. The procedure is a relatively simple one and it should find application among the elderly in whom minimal surgical trauma is indicated.

KENNETH H. SPONSKEL, M.D.

**Treatment of Discrepancies in the Length of the Lower Extremities during Growth** (Le traitement des inégalités de longueur des membres inférieurs pendant la croissance) PIERRE DEATRAND and ALBERT TRILLAT *Rev orthop.*, Par 1948 34: 164.

Differences in leg length may be due to congenital factors (atrophy with or without skeletal anomalies, dyschondroplasia, exostotic disease, hypertrophy of the origin dislocation of the hip), infections (tuberculosis, osteomyelitis, suppurating arthritis), poliomyelitis tumors (fibrocystic osteitis Recklinghausen's neurofibromatosis chondroma giant cell tumor) and traumas.

Two methods may be used to measure the discrepancies the clinical and the roentgenologic, which supplement one another. Evaluation of the prospective growth is of first importance for prognosis and treatment. Of the various methods proposed for this purpose the method of Green and Anderson for poliomyelitis has established averages of sufficient precision.

Before shortening is corrected it is necessary to eliminate the deformities and deviations which create apparent shortenings for instance adduction of the thigh and flexion of the knee or hip. The use of fulcrums of some degree of shortening in certain disorders should not be overlooked.

The inequality in length may become fixed at a certain level after a period of increase or it may de-

crease or increase with growth. Therefore, the evolution of the condition should be observed by taking successive measurements to guide its treatment. Various methods to stimulate growth have been tried. They include direct action on the circulation by venous stasis and venous ligation physical therapeutic agents (diathermy or short waves) action on the lumbar sympathetic by infiltrations or resection, and direct action on the bone by the incorporation of foreign bodies. Ferguson's procedure and detachment of the perosteum. The methods used to inhibit growth include roentgen therapy epiphysal resection of the conjugation cartilage the procedure of Haas and vascular operations.

In the present status of the technique of lengthening osteotomies these operations must be regarded as offering many risks and should be used only in naturally short patients having a short extremity with bones of sufficient diameter without previous or actual infection and after growth has stopped. In general shortening operations are functionally less serious and result less frequently in failure. In most cases the healthy extremity is shortened.

The indications for the various methods vary principally with the age of the children. Up to the age of 8 years the stimulating methods alone should be used vigorously and with perseverance, and even in mild cases since a shortening of 2 cm which is insignificant in an older child may indicate a serious involvement of the growth potential in a young child. When possible diathermy is preferred, second choice going to intra articular injections of blood. In severe cases i.e. those in which the difference in length increases regularly recourse may be made to surgical measures preferably detachment of the perosteum lumbar sympathectomy and venous ligations. These methods are probably those of the future they allow stabilization of shortening at its onset and are without danger. At the age of 8 years the question arises of slowing down the growth on the healthy side by epiphysalodesis as roentgen therapy does not fulfill the requirements. At the end of the growth period i.e., practically after the age of 13 or 14 years the equalization methods may be considered when the shortness becomes burdensome (5 cm or more). Lengthening being a serious operation which presents frequent complications should be reserved for special cases while shortening being safer should be recommended in most cases.

RICHARD KEMEL, M.D.

**Penicillin Therapy In Open and Closed Suppurative Arthritis of the Knee Joint** (Penicillinoterapija na otvoreni i zatvoreni gnojni artriti na kolennata stava) GEORGI KRASTINOV *Chir orthop Sofia* 1948 No 2 83.

Fifteen cases of traumatic suppurative arthritis of the knee have been observed at the university clinic of Plovdiv, Bulgaria, during the period from 1940 to 1948. Ten of these were open wounds received mostly from knife or hatchet cuts connected with woodworking; 4 were closed infections and 1 case

and operation is restricted to cutting away the soft parts which block the acetabulum.

The total number of operations performed was 318, made up of 119 primary open reductions, 96 open reductions with shortening of the femur and 103 secondary open reductions for luxation after closed treatment. There were 5 deaths. Among the patients under 2 years of age whose hips were operated upon, the ligamentum teres was present in 23 and absent in 12. Among the 23 cases in which the ligamentum was present epiphysitis developed in 11 (47.8%). Among the 12 cases without the ligamentum, epiphysitis developed in only 2 (16.7%). The results are better when the child is under 3 years of age. The period between second and third birthdays of the patient was selected as the most favorable one for open reduction. After open reduction with shortening of the femur a fair reduction was obtained in 77 per cent of the patients. Ankylosis a high degree of coxa vara, and necrosis of the head were the poor results. Operation for bilateral dislocation is advantageous only in children under 6 years of age and in older patients open reduction is good only for unilateral luxation. The results after open reduction followed by relaxation and secondary subluxation are not so satisfactory as after primary open reduction but they are good enough to justify an operation.

RICHARD J. BOWETT JR., M.D.

**On Complications Following Nailing Arthrodesis of the Hip Joint** A. KATZ *Acta orthop scand* 94, 7, 95.

This analysis is confined to hip arthrodesis for arthritis deformans. At first intra-articular and juxta articular arthrodeses were performed, but more recently various nailing arthrodeses have been practiced. It was hoped that absolute fixation would both relieve the uncomfortable postoperative symptoms and encourage earlier and firmer bony consolidation.

**TABLE I.—RESULTS WITH RESPECT TO ANKYLOSIS IN 94 NAILING ARTHRODESSES PERFORMED**

Operative method	Number of Operations	Results			
		Bony Ankylosis	Fibrous Ankylosis	No Ankylosis	Deaths
Transarticular nailing arthrodesis	46	24	20	—	—
Intra-articular arthrodesis + transarticular nail (long)	3	10	3	2	—
Intra-articular arthrodesis + transarticular nail (short)	7	9	4	—	3
Osteotomy + intra-medullary trans-articular nail	8	7	—	—	—
	94	46	27	11	3
		49%	29%	10%	3.2%

In the nailed group 90 patients had 95 operations, each of 5 patients had a second operation. At first simple transarticular nailing arthrodesis was used, but frequently there was a gradual slipping of the nail. Then indented or fenestrated nails from 12 to 17 cm. long were used. These nails did not slip, but fracture of the nails occurred. Simple transarticular nailing arthrodesis has been largely discarded for nailing combined with intra-articular arthrodesis. In poor risk operative patients, a satisfactory procedure for the correction of deformity and arthrodesis is subtrochanteric osteotomy combined with intramedullary transarticular nailing.

The following complications have occurred: death from pulmonary embolism, fat embolism, or coronary failure in 3 cases; thromboembolism in 1 case with a resulting death; infection in 1 case resulting in only fibrous ankylosis; peroneal paralysis, 1 case; bilateral which cleared, and 1 case with residual paralysis of the anterior tibial muscle; slipping of the nail in several early cases; fracture of the long nail in at least 8 of 18 cases in which transarticular nailing only was performed; fracture of the femur in 9 cases, 3 being incident to the operative procedure, 1 being the result of trauma, and 5 diagnosed as "insufficiency fractures."

Fracture of the nail was a disturbing factor and occurred in 9 of 57 or 33.3 per cent, of the patients subjected to simple transarticular nailing, and in 3 of 13 or 23.1 per cent, subjected to transarticular nailing combined with intra-articular arthrodesis. This probably occurred because of the shorter postoperative rest in bed. Thus it might be avoided by longer periods of bed rest, but then the operation would fall in one of its main purposes. Actually some patients were later kept in bed about 3 months. This gives no advantage over intra-articular and juxta articular arthrodesis with bone grafting.

In referring to Tables I and 2 a comparison of the results of the nailing type of arthrodesis with the

**TABLE II.—RESULTS WITH RESPECT TO ANKYLOSIS IN 53 PATIENTS SUBJECTED TO PARTIAL AND TOTAL INTRA-ARTICULAR ARTHRODESSES COMBINED WITH JUXTA-ARTICULAR BONE GRAFTING**

Operative method	Number of Operations	Results			
		Bony Ankylosis	Fibrous Ankylosis	No Ankylosis	Deaths
Partial intra-articular arthrodesis with juxta-articular bone grafting	41	7	—	—	—
Total intra-articular arthrodesis with juxta-articular bone grafting	12	10	—	—	—
	53	17	—	—	—
		32%	—	—	—

Died of bronchopneumonia 24 months after operation.

**Two-Stage Reduction of the Posterior Marginal Fragment in Dupuytren's Fracture** (*Réduction en deux temps du fragment marginal postérieur dans la fracture de Dupuytren*) CH. A. PRAUER *Heidel. chir. ads.*, 1948 15 235.

When Dupuytren's fracture is complicated by the presence of a large tibial, marginal posterior fragment which is displaced upward, and continuous extension obtained by means of a Kirschner pin passed through the calcaneus is used, the fragment does not always move down far enough to reassume its normal place and the functional result is often unsatisfactory. The fractured surface of the fragment and the corresponding surface of the tibia are rough and present bony prominences which prevent the fragment from sliding down. In addition the fragment is kept firmly in contact with the tibia by the traction applied to the muscles and tendons of the flexors of the foot and toes during the continuous extension, and the reflex tonus of these muscles is stimulated by the pain, hematoma, and displacement of the fragment over which they slide without friction under normal conditions. Thus, manual or continuous extension keeps the two rough surfaces one against the other and prevents reduction. Another unfavorable factor may intervene after the foot is put back in place: traction is generally exerted parallel to the axis of the leg and the weight acts through the calcaneus and the posterior wall of the capsule of the tibiotarsal joint on the inferoposterior edge of the fragment which then tips backward and catches its inferoanterior edge against the fractured surface of the tibia.

To eliminate these obstacles to reduction in Dupuytren's fracture it is necessary to use the following method:

1. The foot must be temporarily kept in its position of subluxation backward and its lateroexternal displacement alone corrected.

2. From the onset, the traction must be exerted in an oblique descending direction which sometimes aggravates slightly the backward subluxation of the foot. Under these conditions a traction of from 5 to 7 kgm. opens the interfragmental space and pulls the inferoanterior edge of the fragment away from the tibia and dislodges it. This leaves the fragment in contact with the tibia through its proximal end only and allows it to descend.

3. As soon as the fragment is in its place and with continuance of the traction the subluxation of the foot is reduced manually under a short intravenous anesthesia. To maintain reduction a strong padded plaster splint is applied to the anterior surface of the leg and foot and bandaged to the supporting apparatus. Until complete consolidation of the fracture extension is exerted in a rather pronounced oblique ascending direction.

4. When the fracture is consolidated a walking plaster cast enclosing the leg from the knee down and the foot at a right angle and in supination allows the patient to get up and move about.

RICHARD KEMEL, M.D.

**Treatment of Simultaneous Fractures of the Two Bones of the Forearm in Adults** (*Le traitement des fractures simultanées des deux os de l'avant bras chez l'adulte*) R. SOZUK. *Rev. orthop.* Par 1948, 34 301.

Fresh fractures of the bones of the forearm, located in the region of the interosseous membrane and presenting displacement are relatively not frequent in the adult, but their treatment is difficult. In their orthopedic treatment under local or brachial plexus anesthesia, with the patient in dorsal decubitus the elbow flexed at a right angle, and the hand in functional position traction is made separately on the thumb and the fingers through finger coats of braided fiber, and the progress of the reduction is observed by fluoroscopy. Overriding angulation rotation and lateral displacement must be corrected. It is preferable not to pad the plaster cast, which consists of a dorsal splint fixed by a gauze bandage and then by plaster bandages over it. This apparatus must extend from the metacarpal heads to the upper third of the arm with the elbow flexed at an angle of 90 degrees. Immobilization is maintained until clinical and roentgenologic consolidation is obtained; this takes from 8 to 12 weeks and sometimes more. Secondary displacements may occur if the apparatus is supported by a sling. The method offers no danger is applicable to all cases, shortens hospitalization and provides successful results with rapid consolidation, minimal callus and easy functional recovery. Unfortunately it presents also some cases of failure: secondary displacements can be corrected if discovered in time and premature removal of the cast can be avoided but reduction remains the great obstacle no matter how experienced the surgeon may be. Reduction is successful only if the axial angulation is less than 5 degrees in any direction and if coaptation of the fragments amounts to 80 per cent.

Surgical reduction followed by the correct application of a plaster cast suffices to permit healing of many of these fractures but the advocates of this method admit that reduction is not always maintained and that, if the reduction seems unstable during the manipulation it is better to complete it with a prosthesis. Economical osteosyntheses (screws, plates, clips, sutures) have caused numerous disappointments. External fixation is still advocated by some for open fractures but has not been used in recent traumatism. Large ball-exteriorized screws cause osteitis. Bone grafts still serve for pseudarthroses but their complicated technique has eliminated them in cases of fresh fractures. This leaves synthesis by plates, the coaptator of Denis, and medullary plating or nailing.

During past years the plate method has been discredited. The coaptator of Denis consists of a thick hard stainless steel plate, having three holes on the side of its reinforced extremity. It has a groove, at the distal end of which there is a pressure screw; the screws used to fix the appliance to the bone are capable of resisting a tearing-out force from 4 to 5

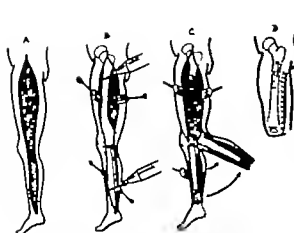


Fig. 1. (Van Nee) Technique of partial turn-up-plasty

was a tuberculous arthritis with secondary suppurative infection. At first, general measures were instituted without immobilization with indifferent results then immobilization was started with the parenteral administration of the sulfonamides, still with unsatisfactory results finally penicillin therapy was instituted with immobilization in a plaster of paris splint or cast. The period of hospitalization then dropped from several weeks to a few days, and when treatment could be adequate, the functional results (both immediate and after follow-up periods of from 3 to 6 months) were invariably good.

The penicillin was always injected intra-articularly in dosages of 5,000 I U an equivalent quantity of joint fluid usually being withdrawn in closed cases. In an open case adhesive was used to seal the articular cavity so that the penicillin solution could be retained. As a rule, from 3 to 5 injections at 3 or 4 day intervals were sufficient to bring down any temperature present, to return the blood picture and sedimentation rate to normal and to produce a sterile joint fluid. Lately the joint has usually been sutured with or without trimming of the wound edges. This changed the open infection into a closed one and in non-suppurative cases shielded the joint against secondary infection.

In 1 case the penicillin brought the temperature down initially but later the patient did not respond very well as there were subfebrile rises in temperature and puncture of the posterior recess of the articular cavity revealed turbid fluid. This recess was then injected separately with complete success. This result causes the author to discuss the anatomical work of Volno-Yasenetzki, who showed that the articular cavity of the knee is divided into anterior and posterior recesses which are connected by narrow communicating passages, and that the posterior recess is also partially divided into two cavities by a sagittal septum consisting of the posterior cruciate ligament with its synovial fringe and Robert's ligament. In infectious conditions these partial septa may become total. JAMES W. BRIDGEMAN, M.D.

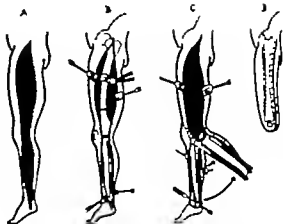


Fig. 2. Technique of total turn-up-plasty

**Transplantation of the Tibia and Fibula to Replace the Femur following Resection "Turn Up-Plasty" of the Leg.** C. P. VAN NEE. *J. Bone Surg.* 1945, 30-A: 854.

Transplantation of the tibia and fibula to replace the femur is indicated in partial or total resection of the femur in cases of tumors, osteomyelitis, or severe trauma. Under tourniquet an incision is made along the entire lateral aspect of the extremity. A partial or total resection of the femur is done. The tibia and fibula are turned up and inserted into the thigh bone in such a manner that the malleolus fits into the acetabulum. In partial resection of the femur, the cut section of the tibia fits the amputation stump of the femur. A small bone graft is inserted to hasten bony union.

The author reports the case of a 21 year old man in whom the femur was excised because of Ewing's tumor. A total "turn-up-plasty" was performed. His second case was that of a 33 year old woman in whom a partial excision of the femur had to be done because of a malignant giant-cell tumor. A partial "turn-up-plasty" was done.

Both patients were satisfactorily fitted with a prosthesis. The operation was successful from the cosmetic point of view. GEORGE L. REES, M.D.

## FRACTURES AND DISLOCATIONS

**The Treatment of Supracondylar Fractures of the Humerus by Kirschner Wire Transfixion.** ALVIN L. SWENSON. *J. Bone Surg.* 1945, 30-A: 903.

After supracondylar fracture of the humerus, the fragments of bone are fixed by means of transfixion wires. This method of blind plating was used in 11 cases in which there was external swelling about the elbow. The wires held the fragments until union occurred except in 1 case. The wires were removed under local anesthesia.

This procedure is recommended when immobilization in acute flexion following closed reduction is not justified. RICHARD J. BROWNETT, JR., M.D.

Nine patients showed arthritic changes clinically and roentgenologically. One case of each of the following occurred: calcification in the joint capsule, persistent displacement of the acetabular fragment with no disability, avascular necrosis of the femoral head, failure of the reduction of the dislocation and open reduction and mold arthroplasty.

A later follow up was made in 15 of the 43 patients of 7 patients previously classified as normal 5 remained so, and 2 complained of slight aching and stiffness. Five arthritic hips remained unchanged. One patient with calcification of the capsule reported some aching. The patient with avascular necrosis remained unchanged and was awaiting arthrodesis. The patient with the mold arthroplasty had satisfactory function with about one half of the normal range of movement.

Cases of dislocation of the hip joint with fracture of the acetabular floor were classified in two groups 3 were of the central type of dislocation and 4 were posterior dislocations involving the floor of the acetabulum. In the central type the hip joint function was lost. The patients had arthritis, and/or fibrous or bony ankylosis. Two posterior dislocations were reduced by traction but eventually traumatic arthritis set in. This group of patients was subject to uniformly poor results relative to hip joint function. Two had sciatic paralysis with incomplete recovery.

In the treatment of dislocation of the hip joint with fracture of the head of the femur three factors had a bearing on the prognosis: (1) the degree of damage to the femoral head, (2) the ease with which displacement could be reduced and (3) the accuracy of replacement of the femoral fragment. Only one of these patients could be considered normal after 16 months. This patient had a fracture with a fragment about one sixth of the femoral head that was in good position following reduction of the hip dislocation. Three fractures in the group of 5 could be reduced by manipulation. One patient with a small femoral head fragment obtained good hip function but had sciatic paralysis which did not leave completely and marred the result. One patient has traumatic arthritis and 2 others were subjected to arthrodesis.

In the whole series 2 patients had dislocations which remained unreduced. Experience showed that late operative reduction and reconstruction or arthrodesis were very difficult. The author cites 1 patient in his previous experience who had a simple dislocation and had excellent function for about 5 years and then developed aseptic necrosis of the femoral head. He wishes to point out that this is not an end result study. He expects that some of the apparently normal hips will develop necrosis of the femoral head and traumatic arthritis or both. Further he states that if the reported results of sciatic paralysis as a complication of acetabular rim fracture can be considered typical, exploration of the sciatic nerve should be performed at the earliest time possible after reduction of the dislocation.

KENNETH H. SPENCE, M.D.

## Fractures of the Neck of the Femur

VAN GORDEL, J. *Am. Med. Ass.*, 1948, 137, 1181

The femoral neck fractures present certain inevitable problems. They occur in old persons at a site in the hip where the bone is narrowest and periosteal callus never forms and where the blood supply is poor. It is also a site of great mechanical strain.

Modern concepts of treatment, in particular the Smith Petersen nail, revolutionized the prognosis both for life and the solid limb of these patients but there is still need to survey the progress and problems of treatment in the light of accumulated experience.

Because of the comfort afforded the patient and the minimum risk involved, nailing may be done in all patients with fracture of the femoral neck, provided only they are not acutely or hopelessly ill. Most surgeons agree that the optimum time is within the first week of injury.

All types of anesthesia are advocated but most surgeons use either spinal or some form of general anesthesia for patients under 60 years of age and for others local, supplemented by gas-oxygen or ether at the time of reduction and nail insertion.

The success or failure of treatment depends upon securing an accurate reduction. Roentgenograms taken in both anteroposterior and lateral planes after 24 hours of moderate traction correct the external rotation and afford an appreciation of the distinctive features of each fracture so that the most effective means of reduction may be employed. At reduction an effort should be made to secure a position of valgus which converts the shearing force at the fracture site to a pressure force conducive to reunion. Careful study of clear roentgenograms, of accurate reduction.

Once reduction is secured the leg can be held satisfactorily by an assistant who maintains the proper degree of internal rotation and abduction and keeps the knee flexed at a right angle to help lock the fragments in place by keeping the extensor muscles tight. Special tables and traction set ups are not necessary.

Vertical subcapital fractures are the most difficult to manage, for even when reduced the weight bearing line falls across the fracture so as to shear it apart rather than impact it. Often it is necessary to supplement the nail fixation with a bone-graft peg parallel to the nail. When accurate reduction cannot be obtained, either open reduction or an osteotomy must be undertaken.

Under ordinary circumstances the fracture is least disturbed by so-called blind nailing which is generally used. The specific technique may be highly individualized and gadgetized, but the author prefers and describes the procedure as carried out at the Massachusetts General Hospital, Boston.

Aftercare varies tremendously in different clinics but most surgeons keep their patients in bed with or without support for from 3 to 6 weeks then

times greater than that of the usual screws. They are very tightly seated in the respective holes and remain rigid like the teeth of a comb. No plaster cast is used, but the forearm is protected by a reinforced celluloid cuff which is placed in place when the patient goes out or wants to sleep. Consolidation was obtained in 34 cases in which the appliance was used, but synostosis occurred in 4 because of technical errors.

The theoretical objections against medullary pinning, such as danger of embolism, massive infection of the bone marrow, moving of the pin, have been refuted by the facts. The method is simpler than the other osteosyntheses, surgical trauma is minimal and reduction is necessarily good. Insertion of the pin is easy in the ulna but somewhat more difficult in the radius. Retention of the fragments is solid and allows early resumption of movements. Results are encouraging.

As to the question whether open reduction should be used systematically or efforts be made to perfect the subcutaneous method, Sourc thinks that, perfect reduction being essential, surgical exposure of the fragments is indicated. Medullary pinning or nailing is gaining in favor. However, this does not mean that the orthopedic method should be abandoned since there will always be some cases in which osteosynthesis is unnecessary or contraindicated.

RICHARD KEMEL, M.D.

#### Traumatic Dislocation of the Hip Joint. J. R. ARMSTRONG. *J Bone Surg* 94A, 30-B 430

This report deals with the types of traumatic dislocations of the hip joint and the early results in 101 cases in the Royal Air Force hospitals. The incidence of dislocation of the hip was 1 in 350 admissions.

Before the era of motor vehicles, the classical cause of dislocation was wide and forcible abduction of the lower limbs, the limb acting as a long lever to force the femoral head through the inferior aspect of the joint capsule. Anterior posterior or inferior dislocation occurred according to the amount of internal or external rotation of the extremity at the time of injury. In this series, only 8 dislocations were of this type, and 93 were due to considerable violence of high velocity acting in the line of the shaft of the femur.

The exact nature of the dislocation depends upon the position of the limb when the force is applied. If the hip joint is flexed and adducted, the head of the femur is driven out of the back of the joint where the capsule is weak and the acetabulum relatively shallow. With less flexion and less adduction the head is driven against the strong posterosuperior buttress of the acetabulum which is fractured. If the hip is extended and abducted a central fracture-dislocation is produced.

Dislocations of the hip joint can be classified into four main types: simple dislocations, dislocations with fracture of the acetabular rim, dislocations with fracture of the acetabular floor, and dislocations with fracture of the femoral head.

In simple dislocations the management was relatively easy. The treatment soon became uniform in the various centers: namely, reduction by manipulation under general anesthesia, immediate immobilization in a hip spica for 8 weeks, mobilization in nonweight bearing exercise for about 4 weeks, and, finally, treatment at a rehabilitation center for 1 month or 6 weeks with gradual return to full activity.

Patients were classified as normal if there was no muscle wasting, no limitation of movement, no roentgenographic evidence of abnormality and no real discomfort after engaging in full activity. Of 46 dislocations 35 (76 per cent) were associated with no symptoms or disability remaining after a period of treatment ranging from 4 to 7 months. Calcification in the joint capsule with no disability occurred in 3 patients. Arthritic changes in the joint were present in 6 patients. These had slight wasting of the thigh muscles, mild limitation of joint motion, and some discomfort or aching pain which was made worse by exercise. Avascular necrosis of the femoral head occurred once. Myositis ossificans resulted in 1 case in which the patient was treated by massage and early passive and active exercises immediately after reduction. This was continued for 10 weeks.

Late follow up was obtained in 19 of these 46 patients. Fourteen had been considered normal at the conclusion of the early treatment. From 1 to 4 years after the injury only 3 reported that their hips were still quite normal, 6 complained of trivial aching and pain, 3 had vague symptoms only after exertion.

Forty-three patients suffered posterior dislocations with fractures of the acetabular rim. Both reduction of the dislocation and accurate replacement of the bony fragment had to be accomplished. Frequently the fragment will be reduced well with reposition of the hip. In this case treatment was similar to that of simple dislocation. If satisfactory reduction of the acetabular fragment was not obtained in this way the limb was immobilized in traction. In most instances the fragment fell back accurately into place within a few days. Traction was maintained about 6 weeks and then immobilization maintained by plaster spica.

In 1 case with associated sciatic paralysis, the fragment could not be reduced conservatively and open operation with screw fixation was performed. At operation the sciatic nerve was found to be impaled over the fragment. Complete nerve recovery occurred in 6 months. This was the only complete recovery among 3 cases of complete sciatic paralysis and 5 cases of external popliteal nerve paralysis. Two other patients were explored several months later but nerve function did not improve. In these 2 cases, the nerve was likewise sharply indented by a bony fragment of the acetabulum.

Results in dislocation with fracture of the acetabular rim were not as good as in simple dislocations. Twenty-seven of the 43 patients (63 per cent) were considered normal after completion of the early treatment. Two patients died shortly after injury.

Nine patients showed arthritic changes clinically and roentgenologically. One case of each of the following occurred: calcification in the joint capsule, persistent displacement of the acetabular fragment with no disability, avascular necrosis of the femoral head, failure of the reduction of the dislocation and open reduction and mold arthroplasty.

A later follow up was made in 15 of the 43 patients. Of 7 patients previously classified as normal 5 remained so, and 2 complained of slight aching and stiffness. Five arthritic hips remained unchanged. One patient with calcification of the capsule reported some aching. The patient with avascular necrosis remained unchanged and was awaiting arthrodesis. The patient with the mold arthroplasty had satisfactory function with about one-half of the normal range of movement.

Cases of dislocation of the hip joint with fracture of the acetabular floor were classified in two groups: 3 were of the central type of dislocation and 4 were posterior dislocations involving the floor of the acetabulum. In the central type the hip joint function was lost. The patients had arthritis, and/or fibrous or bony ankylosis. Two posterior dislocations were reduced by traction but eventually traumatic arthritis set in. This group of patients was subject to uniformly poor results relative to hip joint function. Two had sciatic paralysis with incomplete recovery.

In the treatment of dislocation of the hip joint with fracture of the head of the femur three factors had a bearing on the prognosis: (1) the degree of damage to the femoral head, (2) the ease with which displacement could be reduced, and (3) the accuracy of replacement of the femoral fragment.

Only one of these patients could be considered normal after 16 months. This patient had a fracture with a fragment about one-sixth of the femoral head that was in good position following reduction of the hip dislocation. Three fractures in the group of 5 could be reduced by manipulation. One patient with a small femoral head fragment obtained good hip function but had sciatic paralysis which did not leave completely and marred the result. One patient has traumatic arthritis and 2 others were subjected to arthrodesis.

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KENNETH H. SPONDEL, M.D.

Fractures of the Neck of the Femur. GEORGE W. VAN GORDEL. *J. Am. Med. Ass.* 1948 137 1181.

The femoral neck fractures present certain inevitable problems. They occur in old persons at a site in the hip where the bone is narrowest and periosteal callus never forms and where the blood supply is poor. It is also a site of great mechanical strain.

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All types of anesthesia are advocated but most surgeons use either spinal or some form of general anesthesia for patients under 60 years of age and for others local supplemented by gas-oxygen or ether at the time of reduction and nail insertion.

The success or failure of treatment depends upon securing an accurate reduction. Roentgenogram taken in both anteroposterior and lateral planes after 24 hours of moderate traction, correct the external rotation afford an appreciation of the distinctive features of each fracture so that the most effective means of reduction may be employed. At reduction an effort should be made to secure a position of valgus which converts the shearing force at the fracture site to a pressure force conducive to reunion. Careful study of clear roentgenograms again taken in both planes, is necessary to be assured of accurate reduction.

Once reduction is secured, the leg can be held satisfactorily by an assistant who maintains the proper degree of internal rotation and abduction and keeps the knee flexed at a right angle to help lock the fragments in place by keeping the external muscles tight. Special tables and traction set-ups are not necessary.

Vertical subcapital fractures are the most difficult to manage for even when reduced, the weight-bearing line falls across the fracture so as to shear it apart rather than impact it. Often it is necessary to supplement the nail fixation with a bone-graft perpendicular to the nail. When accurate reduction cannot be obtained, either open reduction or an osteotomy must be undertaken.

Under ordinary circumstances the fracture is least disturbed by so-called "nailing" which is generally used. The specific technique may be highly individualized and "personalized" as the author prefers and describes the procedure as carried out at the Massachusetts General Hospital.

Aftercare varies tremendously—different doctors but most surgeons keep the patients in bed, with or without support for 6 to 8 weeks.



permit crutch-walking without weight-bearing. Early weight bearing may be dangerous and only when there is roentgen evidence of solid union may it be safely permitted.

The prognosis in fractures of the femoral neck depends largely upon the site and obliquity of the fracture line. Excellence of nursing care is the other major factor in survival of this elderly type of patient.

FRANCIS E. BRENNER, M.D.

#### ORTHOPEDICS IN GENERAL

Criteria for Spine Fusion Following the Removal of a Protruded Nucleus Pulposus. GUY A. CALDWELL and WILLIAM B. SHEPARD. *J Bone Surg* 94B, 30-A: 97.

In follow-up studies for from 3 to 7 years it was found that excellent results were obtained in about as many cases treated by laminectomy as in those treated by the combined operation. Hypertrophic changes were found in nearly two-thirds of all the patients operated on, with or without narrowing of the intervertebral space.

Recurrences were observed in 8 per cent of all patients treated and had no relation to the history, physical findings, anomalies or postoperative observations.

The author suggests that spinal fusion be limited to a selected group of cases of protrusion of the intervertebral nucleus pulposus.

GEORGE I. REINA, M.D.

Clinical Study of Muscular Torticollis (Die Klinik des muskulären Schiefhalses). C. J. GARD. *Geburtsh. & Frauenz.* 947: 7, 161.

On the basis of 40 years of study of the clinical aspects of muscular torticollis the author is inclined to reject the theory of a traumatic or traumatic inflammatory origin of this condition. He is more inclined to favor the theory of intrauterine pressure as a causative factor, thus admitting the possibility of indirect heredity in the nature of a familial predisposition to breech presentation.

Roentgenograms taken during pregnancy (lateral flexion of the head with elevation of the posterior shoulder) as well as postnatal demonstration of

threatening caput obstipum (atrophy of the sternocleidomastoid muscle) of beginning caput obstipum (induration of this muscle) and of fully developed caput obstipum (shortening of the muscle with inclination of the head) serve to complete the clinical picture of congenital torticollis.

With the diagnosis of threatening caput obstipum possible at birth, the immediate institution of orthopedic measures may spare many patients later surgical intervention. A valuable prophylactic measure would be the early conversion of a breech presentation during pregnancy, which would likewise serve to reduce infant mortality considerably and would be justifiable for this reason alone.

NORTH SCRAMPER MOORE.

The Response of the Quadriceps Femoris to Progressive-Resistance Exercises in Poliomyelitic Patients. THOMAS L. DELORME, ROBERT S. SCHWAB, and ARTHUR L. WATKINS. *J Bone Surg* 94B, 30-A: 834.

This study is based on 27 quadriceps femoris muscles. Spring scales and ergograms, work capacity, limb volume, electrical activity, and the ability to perform ordinary activities with less effort and fatigue were used to evaluate the progress of the treatment.

It was found that the remaining innervated muscles following acute anterior poliomyelitis increased in strength and work capacity in much the same manner as normal muscles.

GEORGE I. REINA, M.D.

Policlization of the Index Finger. JAMES B. CUTBERT. *Bril J Plast. Surg.* 94B, 56.

A case of successful substitution of the index finger for an amputated thumb is presented in this article. Only a short first metacarpal stump remained following a gunshot wound of the hand. Operation was carried out in stages, great care being taken to preserve the nerve and blood supply of the new digit. In five stages, a useful new thumb with an excellent cosmetic result was obtained. The principles of policlization of the index finger and the details of each stage are presented.

JOHN L. BELL, M.D.

# SURGERY OF THE BLOOD AND LYMPH SYSTEMS

## BLOOD VESSELS

Discussion on Primary Treatment of Varicose Veins.  
A. DICKSON WRIGHT, J. B. KINMONTH, A. M. BOYD  
PETER MARTIN and Others. *Proc. R. Soc. M. Lond.*  
1948 41 631

DICKSON WRIGHT A radical attack now in use by this author for the primary treatment of varicose veins is to ligate as many veins as necessary while the patient is under a general anesthetic. One hundred cubic centimeters of 30 per cent saline solution is used to inject every varix thoroughly and obtain obliteration of the whole network of varices and the deep communicating veins at once. Bandaging the leg with elastoplast reduces the bulk of the clot. Any vein escaping this onslaught is injected at postopera-

tive visits. The contraindications to treatment are old age, obesity and diabetes. If arterial disease is present, great caution is indicated.

The complications of treatment are important. If a thrombophilia is stirred up anticoagulants must be used.

Allergic response to the solution is treated with adrenalin, ephedrine and benzedrine.

The complications of varicose veins, thrombosis, eczema, and pruritus are all cured by obliteration of the varicose vein, except in patients with incompetent deep veins or old femoral thrombosis. These are treated with various types of compressive bandages, bed rest or both.

KINMONTH reports a study of 100 venograms made at operation and on outpatients. Histological studies were also carried out on portions of veins removed at operation from some 20 patients who had had previous vein injections.

1 Retrograde injection at operation. A series of venograms made by injecting from 1.5 to 8 c.c. of a radiopaque solution suggests that this method is inefficient because (a) much of the dye goes straight into the deep veins (b) spasm of the great saphenous vein occurs because of the irritation of the catheter so that little injected fluid stays in the vein (c) little fluid goes below the knee as it tends to pass into the communicating veins or even normal veins. With larger quantities of fluid than 8 c.c. the excess goes straight into the deep veins.

2 Fluoroscopic screening. Dye injected into normal superficial leg veins never passes distally even if there is a tourniquet above the site of the injection. Dye injected into varicose veins with the patient standing sinks rapidly toward the ankle. Dye injected into a varicose vein with the patient lying remains at the site of the injection until the patient moves the limb.

3 Serial venograms of direct injections into leg varicosities show that from 1 to 1.5 c.c. is the optimum amount for a single injection. Larger amounts

tend to spill over into the deep veins. Entry to the deep veins is particularly likely to occur as would be expected in tributaries of the small saphenous vein at the back of the calf.

Serial pictures also revealed that fluid passing into the deep veins remains there longer than one would expect it is not instantly swept away but may often be seen still lying in some concentration a minute or more after injection. It remains for a longer time still in the communicating veins and can often be seen lingering around the valves. As valves are delicate structures this observation is to be considered a significant one.

Histological studies. Small portions of veins were excised from patients who had injections a few days beforehand. Often inadequate clinical takes revealed edema of the walls and clotting. These changes were most marked at the region of the valves, which often were adherent when no clinical take had been obtained.

## CONCLUSIONS AS TO TREATMENT

1 For serious cases with incompetent great saphenous valves a high saphenofemoral ligature, probably combined with ligature at the knee level or in the thigh if a communicating vein blow-out is indicated should be made. No retrograde injections are to be made. Local injection of the calf varicosities should be done if necessary at a later date.

2 For mild cases the affected vein should be injected by means of an empty vein technique with the limb horizontal. Not more than 1.5 c.c. should be given in each injection. The leg is to be kept still for 5 minutes and then moved vigorously to sweep the fluid away.

BOYD A follow up study of 60 patients treated at St. Bartholomew's Hospital over an 8 year period revealed a steady increase in the recurrence rate year by year. The reason for these unsatisfactory results lies in the etiology of varicose veins. Varicose veins are primarily due to a congenital weakness of the valves. The condition is progressive. No angle of operation is likely to cure them.

Pain in varicose veins is caused by varices in the muscular communicating veins of the calf complete dilatation of the internal saphenous vein involvement of the cutaneous nerves in periphlebitis or deep phlebitis of the calf.

Deep phlebitis is not a contraindication to ablation of the superficial varices. It is in fact an indication for operative treatment.

Chronic swelling of the leg with no history of phlebitis may at times be due to varicosities of the deep veins.

Treatment. The sheet anchor of treatment is ligation. In addition to proximal ligation distal ligations at the sites of incompetent perforating veins should be undertaken.

It is important to look for an accessory saphenous vein, which at times perforates the fascia distally and joins the femoral vein below the fossa ovalis.

Despite older opinions, no harm can come from leaving a stump of the internal saphenous vein and one will not injure the femoral vein if he ligates at a safe distance.

A short segment of the internal saphenous vein including the perforating vein should be removed in the lower third of the thigh. The communicating vein often found behind the knee between the external and internal saphenous veins should be ligated if present.

Deep phlebitis occasionally follows retrograde injection of sclerosing solutions. A retrograde injection of pylectan into the distal end of the saphenous vein divided in the groin has been shown by roentgenograms to enter the femoral vein via the perforating veins in every case in which it was used.

If the retrograde injection is carried out at the knee level the radiopaque solution could only occasionally be seen in any quantity in the popliteal vein.

These tests show that retrograde injection at the groin is unsafe, and that injections of not more than from 3 to 5 c.c. at knee level are in most cases quite safe.

EDMUND R. DOMAGALA, M.D.

**The Symptoms and Treatment of Arterial Aneurysm of the Upper Extremities (Das Aneurysma der Arterien der oberen Gliedmaßen, seine Erscheinungen und Behandlung)** KARL BASTENIER. *Chirurgia*, 1935, 9, 304.

The author presents a series of 37 cases of arterial aneurysm of the upper extremities. Because of favorable anatomic conditions, a good collateral circulation often develops, so that in a certain number of cases ligation is possible. Routine ligation is not to be recommended, however, since it may be followed by serious circulatory disturbances and necrosis. If the collateral circulation cannot be rated as 100 per cent efficient before or during operation, an attempt must be made to restore the normal passages after removal of the aneurysm. The simple technique of lateral and circular suture can be used in only a few cases. If a large arterial defect remains following removal of the aneurysm, it must be repaired by plastic operation on the veins.

The majority of the sutured arteries appeared permeable in the arteriogram following operation but even with nonpermeable sutures and transplants, the clinical results were satisfactory since the sutures and transplants heal only gradually and only with a properly functioning collateral circulation. At any rate, the excellent clinical results obtained by sutures and transplants, in contradistinction to

ligation indicate a satisfactory restoration of the normal blood route.

The marked involvement of the nerves in almost all arterial aneurysms of the upper extremities was a striking feature. The nerves were affected chiefly by pressure of the aneurysmal sac, which stressed the indication for the earliest possible operation. However, nerve injuries occur also in cases of pure fistula. The disturbances are particularly marked following the anastomosis of an arteriovenous fistula with a large aneurysmal sac, because in these cases not only pressure injuries but also poor circulation in the periphery plays a part. Removal of the aneurysm and restoration of the normal channel by early operation may prove a requisite for the return of nerve function. Prolonged delay in operating may lead to most severe atrophy and dystrophic disturbances with contracture of the muscles and ankylosis. The best prophylaxis of these serious complications lies in primary suture of the vessels. The diagnosis, nerve involvement, treatment and results of treatment in these 37 cases are tabulated. The cases include aneurysms of the axillary artery and of the brachial artery and its branches. The diagnostic value of arteriography is stressed. This procedure permits demonstration of the exact site of the aneurysm, the venous involvement and frequently also of the state of the collateral circulation. Ligation is justified when arteriography reveals a good collateral circulation when the distal portion of the main artery is obliterated and its function has been assumed by a larger branch, or when the main artery is so narrow that a good collateral circulation must be assumed.

Ligation of the afferent artery without radical operation on the aneurysm cannot be recommended, except in certain special cases of ligation of the hypogastric artery in aneurysms of the gluteal artery. An arteriovenous aneurysm can be cured only by complete separation of the artery and vein. Because of the poor results obtained by ligation of the main artery the author attempted restoration of the natural route in all cases with a good collateral circulation. Lateral suture, although yielding excellent results, is rarely feasible because the arterial defect is usually so large that a resection of the area is necessary. The arterial stumps have then to be united by direct suture. This yielded excellent results in 3 cases. In 10 cases the arterial defect was repaired by venous transplantation. In 6 of these cases the aneurysm was purely arterial with a very large sac. In some cases, in 2 cases there was an arteriovenous aneurysm and in 2 others a pure arteriovenous fistula. No significant circulatory disturbances occurred. In 31 of the 37 cases, the nerves were involved.

EDITH SCHANKER MOORE.

## SURGICAL TECHNIQUE

### OPERATIVE SURGERY AND TECHNIQUE

#### POSTOPERATIVE TREATMENT

Entity and Significance of Variations in Plasma Proteins in the Normal Postoperative Course (Entità e significato delle variazioni proteinemiche nel decorso postoperatorio normale). ANTONIO LARZARA, ALDO VITI and FRANCO CRUPPI. *Polichinico sez. chir.*, 1948, 55: 75

The causes of hypoproteinemia may be summarized under three headings: (1) chronic malnutrition; (2) loss of protein from the body; and (3) deficient protein formation. Studies of plasma proteins were undertaken in eight groups of surgical disorders to ascertain the presence or extent of these factors in the normal postoperative course. Treatment consisted essentially in the replacement, volume for volume, of fluid lost.

For the quantitative determination of plasma proteins a refractometric method was employed the results of which are likely to run from 7 per cent to 10 per cent higher than those obtained by the Micro-Kjeldahl method.

In 14 cases of thyroid surgery only minor and insignificant changes were observed in the total proteins. In those instances of simple goiter as in Basedow's disease the albumin-globulin ratio declined postoperatively but regained the preoperative level by the seventh day.

In 24 patients who underwent gastroduodenal surgery all showed normal preoperative protein values. The average postoperative values for total protein as well as for albumin-globulin were more markedly reduced than in the first group.

Five of a total of 11 gynecological cases showed inversion of the albumin globulin ratio.

The 10 patients who underwent appendectomy differed from preceding groups in that they showed less variability in postoperative protein values.

Four further groups, including patients with diseases of the biliary tract diseases of the lungs patients who had undergone minor surgical procedures and one patient who had undergone major surgery demonstrated total protein and albumin globulin curves at minor variance only from those of the other groups.

The authors conclude that the variations noted in the albumin-globulin ratio are of humoral origin and that surgical procedures with uneventful recoveries are not characterized by significant shifts in plasma protein concentration.

EDITH B. FARNSWORTH, M.D.

The Significance of Urine Chloride Determination in the Detection and Treatment of Dehydration with Salt Depletion. K. KELLER VASIVK and EVERETT LOUIS EVANS. *Ann Surg* 1948, 128: 391

Primary water depletion is a form of dehydration due to the inadequate intake of fluids while primary

salt depletion is due to the abnormal loss of salt from the body also resulting in dehydration because of the fact that the kidneys will not retain water without salt.

In primary water depletion plasma chloride concentration remains normal the extracellular fluid becomes hypertonic, water passes across the cell membrane into the extracellular space, and there is a diminished output of water by the kidneys. As a result, intracellular dehydration becomes marked but no change may be detected in the plasma volume or in the electrolyte concentration.

In primary salt depletion hypotonicity of the extracellular fluid is averted by excretion of water without salt by the kidneys. The urine of patients with either water depletion or salt depletion shows more significant variations in volume and salt concentration than those found in the plasma. The severity of the depletion can be ascertained by changes in the chloride the carbon dioxide the specific gravity and the hematocrit of the blood.

Water and salt depletion and replacement were studied in 3 healthy volunteer students. From these experiments the authors concluded that salt and water balance was normally maintained when urinary excretion exceeded 1,500 ml. and the salt excreted averaged 3 gm. per liter. Urine salt determination by the Fanning method served to indicate the type of intravenous therapy needed. Thus an excess of 3 gm. of salt per liter of urine justified an infusion of water whereas a concentration of salt less than 3 gm. per liter indicated the infusion of a saline-containing fluid. Measurement of the urine volume were indicative of the need of water replenishment. In patients with impaired kidney function the plasma chloride should be measured to determine the degree of salt depletion.

In every case the discussed laboratory guides should be accompanied by clinical examination for edema, skin turgor thirst respiration and mental status.

BENJAMIN G. P. SHARITOFF, M.D.

Further Experiences with Peritoneal Irrigation for Acute Renal Failure. HOWARD A. FRANK, ARTHUR M. SELIGMAN and JACOB FINE. *Ann Surg* 1948, 128: 561

This report is based on a study of 18 cases of acute renal insufficiency treated by peritoneal irrigation. Since the earlier work on hemodialysis, improvements have been made in the apparatus and in the irrigating fluid. The amount of sodium chloride was reduced to prevent hyperchloremia calcium ions were doubled because of the hypocalcemia due to uremia, phosphates were omitted from the solution because of the hyperphosphatemia, and gelatin was added to obviate the absorption of water. Heparin and penicillin were no longer added to the irrigating solution. The sump drain is placed under the costal

margin and through a subcutaneous tunnel which is directed into the peritoneal cavity at the lower end of the abdomen. Three lines feed the mechanism one to the fluid carboy another to the suction line and a third to the air inlet. The drainage fluid is frequently examined for bacteria and lymphocytes. Irrigation is stopped after 73 hours to avoid peritonitis. Because of anorexia, vomiting and ileus, the gastrointestinal tract is intubated. Parenteral fluids are limited to about 1 liter daily in order to prevent overhydration. By means of peritoneal irrigation, from 25 to 50 gm. of urea can be extracted from the blood in 24 hours.

Peritonitis remains as the most serious complication of irrigation with the colon bacillus as the causative organism. Streptomycin was given only after the peritonitis was diagnosed but penicillin and sulfaalidine are used for prophylaxis.

In the present series 14 of the 18 patients died, 5 because of irreversible kidney lesions. Three patients died because of the peritonitis which developed as a result of irrigation. The etiology of the renal insufficiency in the 4 patients who recovered was sulfathiazole poisoning, shock incompatible blood, and eclampsia. Renal recovery consisted in the return of glomerular function followed by the slower return of tubular function. Urine volume excretion becomes markedly increased. Its specific gravity ranged from 1.003 to 1.010 the urine was usually alkaline and had a urea concentration not greater than twice the urea of plasma. The large loss of chlorides during the phase of diuresis may cause severe dehydration and is indicative of inadequate renal function. With improvement of tubular function the specific gravity of the urine rises acidity increases and acidosis and hyperphosphatemia subside. Complete recovery to normal kidney function is not attained. Peritoneal irrigation is not suitable for routine clinical use.

BENJAMIN G. P. SHATTROFF, M.D.

**The Treatment of Renal Insufficiency in the Surgical Patient.** FREDERICK A. COLLIER, KENNETH N. CAMPBELL, and VIVIAN IOR. *A. S. Surg.* 94:3, 28, 379.

Acute renal insufficiency can be divided into four clinical phases: the period of hypotension; the period of oliguria or anuria; the phase of diuresis; and the final or recovery phase. The treatment in the first period consists of the use of blood transfusions, oxygen, and intravenous fluids. This is a preventive period. When the diagnosis of anuria is made, the blood type should be carefully checked and extrarenal causes for renal obstruction should be eliminated. During the second phase the total fluid intake should be restricted to the insensible loss due to perspiration and respiration. The amount of fluid intake should be limited to about 1 liter given either orally or intravenously. The nonprotein nitrogen and the carbon dioxide combining power of the blood are determined at frequent intervals. When the latter falls to 40 per cent or lower correction is made

by means of the oral administration of sodium bicarbonate or the intravenous administration of sodium lactate. Calcium gluconate is administered intravenously each day to prevent tetany. If tolerated, the patient is allowed food by mouth with limitation of salt to from 500 to 800 mgm. daily. If edema is present the salt and fluid intake is rigidly limited.

During the phase of recovery diuresis with the loss of abnormal amounts of water and salt may cause severe dehydration and hypokalemia. Urine examinations should be made frequently for the estimation of potassium, sodium, and chlorides. The large urine output is replaced by intravenous administration of equivalent amounts of Ringer's solution and oral administration of fluids, or both. After the return to a normal urine output, renal function tests are made to determine the degree of tubular recovery or regeneration.

As a result of this disease process nitrogenous excretion usually does not return to the normal level. Autopsy examination of 4 patients who died of acute renal insufficiency showed lower nephron nephrosis with various stages of regeneration of the tubular epithelium. BENJAMIN G. P. SHATTROFF, M.D.

**Intraseous Infusions in Infants.** E. CLINTON TRYER and D. H. KAUFMANN. *J. Michigan M. Soc.* 1935, 47: 602.

A report of 383 intraseous infusions given to 155 infants is presented, and in only one case was the attempt unsuccessful. The only complications were a subcutaneous abscess in 1 case and a local osteomyelitis in 2 cases, which were controlled by chemotherapy. The infusions consisted of blood and/or electrolyte solutions. Most of the infusions were given to the tibia by positive pressure with a closed system. Twenty five infants expired but in none of the cases was death attributable to the intraseous infusion. This method is quite useful when continuous infusion is indicated as in cases of diarrhea or major surgery. The authors feel that the risk of osteomyelitis has been overemphasized, and roentgenographic studies indicate no significant changes in the bone.

ROBERT MAYO TERRY, M.D.

#### ANTISEPTIC SURGERY; TREATMENT OF WOUNDS AND INFECTIONS

**The Treatment of Lymphedema.** RADFORD MOWLEM. *Bril. J. Med. Surg.* 94:3, 148.

Lymphedema may be caused by injury such as circumferential avulsion of the skin and subcutaneous tissue, or it may be observed as an idiopathic lesion in which the obstruction is in the proximal nodes. The author defines three phases of the clinical and pathological course of the condition and correlates the treatment accordingly. The phase

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present, and the swelling subsides with elevation and rest. This condition may be held in abeyance by a pedicle flap of skin and full thickness subcutaneous tissue from an area of intact lymphatic drainage which bridges the obstruction.

Phase 2 is characterized by marked pitting edema and trophic changes in the skin. Spontaneous fibrosis of the dilated lymphatics and surrounding tissues manifest in the pathologic section. A pedicle bridging the obstruction may halt further progress but will not correct the damage already present.

Phase 3 shows irreversible changes in the skin and subcutaneous tissue, which have become sclerosed. There is no response to elevation and rest, and a pedicle flap will not alter the appearance of the limb. The author recommends excision of the skin and subcutaneous tissue down to the deep fascia, and replacement with skin grafts upon the intact deep fascia.

Eighteen patients have been treated by the methods described. The article contains several photographs of patients before and after treatment. A short review of other methods of treatment is included.

JOHN L. BILL, M.D.

**The Intra Arterial Administration of Penicillin in the Treatment of Infections (Penicillina Intra-arterial no tratamiento das infecções)** DOWATO D. AROZIO. *Rev. brasil. cir.*, 1948, 17, 431.

The technique used by D. Angelo is that of subdiastolic pressure adopted by Shaffer in 1947. The only contraindication to the treatment is the presence of an infected area at the site of injection. In this technique 1 gm. of papaverine hydrochloride is given subcutaneously 30 minutes before the injection of penicillin to help vasodilatation, and the extremity is washed with a tepid solution of potassium permanganate (1:9,000), which acts as a fungicide and deodorant (gangrene) and also as an adjuvant vasodilator because of its temperature. An arterial pressure cuff is applied directly above the lesion, and a 10 c.c. syringe with a short beveled needle is used. The site of injection is in the fold of the elbow for the upper extremity and in the inguocrural region for the lower extremity; the technique for infiltration used for the descending aorta with compression of the two femoral arteries to restrict diffusion of the solution if the carotids are used they may or may not be compressed after the injection.

Under local asepsis the surgeon immobilizes the artery between the index and third finger of his left hand. He introduces the needle vertically into the vessel and injects the penicillin solution at the rate of 1 c.c. per second. As soon as the injection starts the assistant inflates the cuff raising the mercury column to 80 mm. where he keeps it for 10 or 15 minutes. If for any reason it is necessary to repeat the puncture which is difficult because the artery is contracted it is best to wait a few minutes before another attempt is made. Injections may be made twice a day at the

same site and also on the following days without any inconvenience. The injection must be given after incision and drainage if these are called for since the pain caused by venous stasis is then less severe.

Empirically injections of 50,000 units of penicillin in 5 or 10 c.c. of isotonic serum were used in 15 cases of localized infection of the extremities with good results. In 1 case of osteomyelitis of the left frontal bone, penicillin was injected alternately in the two carotids without any disagreeable sensation for the patient. The first dose consisted of 250,000 units in 10 c.c. of physiologic serum; the subsequent doses were of 100,000 units.

In the treatment of localized infection of the hand it was noted that the results were the same whether the penicillin was started immediately after incision and drainage, or 48 or 72 hours later; the purulent secretion stopped completely in 24 hours and one additional injection was sufficient to obtain healing.

RICHARD KREML, M.D.

**The Treatment of Malignant Lip Furuncles with Emetine.** EDUARD MELCHIOR. *Surgery* 1948, 24, 724.

Emetine is usually considered strictly an antiamebic drug. However, the good results obtained in the treatment of nonamebic liver abscesses with this drug led the author to extensive trial of emetine in other bacterial infections such as peritonitis, hilar abscesses, and septicemia with good results. He believes that the therapeutic capability of emetine demonstrated in these infections is an antitoxic effect rather than a bactericidal one.

Furuncles which are characterized by acute swelling and pain progressive purulent infiltration of the surrounding tissues formation of multiple millary abscesses in this spreading periphery and the development of signs of systemic involvement are referred to as "malignant furuncles"—more commonly called carbuncles. Emetine was used in a series of 8 malignant furuncles of the lip with significant clinical improvement in all cases. In the first 3 cases the furuncles were treated simultaneously with emetine and incision and these patients showed the most dramatic response to treatment as evidenced by their temperature curves. In Case 1 for example the temperature on admission was 39 degrees. In the temperature rose to 39.5 degrees, a level which persisted the following morning until emetine was started. Immediately there was a drop in temperature, a normal level being reached 3 days later.

Similar results were obtained with treatment by emetine alone. Three of these 5 patients had low normal temperatures to start with but the immediate increase in well-being of the patient decreased in swelling and relief of pain were indices of the effectiveness of the treatment.

In Case 4 for example the patient suffered from pain, low grade fever and insomnia from a lip furuncle of 5 days duration. Emetine was started and that night the patient slept well for the first

margin and through a subcutaneous tunnel which is directed into the peritoneal cavity at the lower end of the abdomen. Three lines feed the mechanism, one to the fluid carboy another to the suction line, and a third to the air inlet. The drainage fluid is frequently examined for bacteria and lymphocytes. Irrigation is stopped after 72 hours to avoid peritonitis. Because of anorexia, vomiting, and ileus, the gastrointestinal tract is intubated. Parenteral fluids are limited to about 1 liter daily in order to prevent overhydration. By means of peritoneal irrigation, from 25 to 50 gm. of urea can be extracted from the blood in 24 hours.

Peritonitis remains as the most serious complication of irrigation with the colon bacillus as the causative organism. Streptomycin was given only after the peritonitis was diagnosed but penicillin and sulfathiazole are used for prophylaxis.

In the present series 14 of the 18 patients died, 5 because of irreversible kidney lesions. Three patients died because of the peritonitis which developed as a result of irrigation. The etiology of the renal insufficiency in the 4 patients who recovered was sulfathiazole poisoning, shock incompatible blood and eclampsia. Renal recovery consisted in the return of glomerular function followed by the slower return of tubular function. Urine volume excretion becomes markedly increased. Its specific gravity ranged from 1.003 to 1.01; the urine was usually alkaline and had a urea concentration not greater than twice the urea of plasma. The large loss of chlorides during the phase of diuresis may cause severe dehydration and is indicative of inadequate renal function. With improvement of tubular function the specific gravity of the urine rises, acidity increases, and acidosis and hyperphosphatemia subside. Complete recovery to normal kidney function is not attained. Peritoneal irrigation is not suitable for routine clinical use.

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During the phase of recovery diuresis with the loss of abnormal amounts of water and salt may cause severe dehydration and hypopotassemia. Urine examinations should be made frequently for the estimation of potassium, sodium, and chloride. The large urine output is replaced by intravenous administration of equivalent amounts of Ringer's solution and oral administration of fluids, or both. After the return to a normal urine output, renal function tests are made to determine the degree of tubular recovery or regeneration.

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A report of 383 intraseous infusions given to 125 infants is presented, and in only one case was the attempt unsuccessful. The only complications were a subcutaneous abscess in 1 case and a local osteomyelitis in 3 cases which were controlled by chemotherapy. The infusions consisted of blood and/or electrolyte solutions. Most of the infusions were given into the tibia by positive pressure with a closed system. Twenty-five infants expired but in none of the cases was death attributable to the intraseous infusion. This method is quite useful when continuous infusion is indicated, as in cases of diarrhea or major surgery. The authors feel that the risk of osteomyelitis has been overemphasized and roentgenographic studies indicate no significant changes in the bone.

ROBERT MAYO TERRY M.D.

## ANTISEPTIC SURGERY; TREATMENT OF WOUNDS AND INFECTIONS

**The Treatment of Lymphedema.** RADKOVSKY MOWLEM. *Brit. J. Plast. Surg.* 1945, 1: 45.

Lymphedema may be caused by injury such as circumferential avulsion of the skin and subcutaneous tissue, or it may be observed as an idiopathic lesion in which the obstruction is in the proximal nodes. The author defines three phases of the clinical and pathological course of the condition and correlates the treatment according to the phase present.

Phase 1 is manifested by swelling of the most dependent part of the limb. No pitting edema is

Respiratory obstruction was another contraindication and relative contraindications were anemia and disease of the lower bowel and of the liver and kidney.

One hour preoperatively atropine sulfate was administered by hypodermic injection. The dosage of pentothal employed was 0.2 c.c. of a 10 per cent solution per pound of body weight. The depth of basal anesthesia was assessed by gentle supraorbital pressure or pressure on the ear cartilage. Narcosis was never deep enough to prevent a response to this stimulus. Induction was carried out with whatever agent or technique the anesthetist deemed advisable: open drop ethyl ether, open drop divinyl ether followed by ethyl ether, nitrous oxide, ethyl ether and oxygen, nitrous oxide and oxygen or pentothal.

Operations performed included all surgical specialties other than thoracic surgery. Tonsillectomy was performed in 103 patients. In 238 of the 300 patients the basal state was classified as good with the patient asleep and there was no response to stimuli other than pain. 56 cases were classified as fair and 6 as failures. The optimum time for administering rectal pentothal was found to be 30 minutes before operating time. Rectal irritations and signs of toxicity or intolerance to the drug were absent. The postoperative course was uneventful. The children became conscious in from 30 minutes to 2 hours with out delirium. The incidence of vomiting was 25.76 per cent as compared with 60 per cent in a group of 150 patients who received morphine and atropine as premedication and 38.53 per cent in 150 patients who received atropine only as premedication. It was found that less ether was required to maintain satisfactory levels of anesthesia when basal narcosis with pentothal was used. MARY KARP, M.D.

**The Use of Myanescin in Anesthesia (L'impiego della mianescina in anestesia)** FRANCESCO BAU, *Poli clinica sez. prat.*, 1948, 55, 901.

In the attempt to find a substitute for curare, Berger and Bradley of England studied the glycerites of ether and it was found that several of these substances provoked relaxation of the skeletal muscles in animals. Of these, myanescin (3-ortho-toloxyl 1,2-propanediol) proved particularly active therapeutically and was found to possess a wide margin of safety. The substance is stable, may be sterilized by heating and may be mixed with a solution of sodium chloride, glucose and with derivatives of barbituric acid. The author has used myanescin exclusively by the intravenous route, either associated with pentothal or with local anesthesia. It has also been employed together with pentothal in the induction of ether anesthesia, and has been given in association with pentothal anesthesia to relax the laryngeal spasm complicating the use of pentothal as an anesthetic agent. The recommendations of Mallison regarding the manner of employing this agent have been followed, however, the large doses (50 c.c.) as proposed by that author were not given.

There seems to be a synergistic relationship between pentothal and myanescin so that less pento-

thal may be used or the anesthetic period can be lengthened out considerably with the same amount of pentothal. With myanescin there is no such discomfort as accompanies the use of curare and none of the paralytic accidents. The only drawback in the use of the former has been a cerebral form of vomiting which lasted a couple of days following the operation. This vomiting has been particularly bothersome when the patient was operated upon while conscious (local anesthesia and myanescin).

Myanescin does not affect the indications for curare; the latter will still be used in operations on the chest in which an absolute arrest of the motions of breathing is desired and myanescin will find its field of usefulness in abdominal surgery where its peculiar efficacy in relaxing the abdominal musculature is valuable. JOHN W. BRENNAN, M.D.

**The Action of Curare in Anesthesia (A ação do curare em anestesia)** VIRGÍLIA DE ARAÚJO, *Gaz. Méd. Portuguesa*, 1948, 1, 299.

The author states that clinically 1 mgm. of Burroughs Wellcome's tubarine produces the same effect as 6.6 mgm. of Squibb's intocostin. Curare is a safe drug to use in combination with certain anesthetic agents and its association with cyclopropane is regarded as giving an ideal anesthesia. With ether the dose of curare must be reduced one third because ether itself has a curariform action. The advantages of curare in anesthesia are that it provides optimal muscular relaxation and thereby facilitates abdominal surgery, avoids laryngeal spasm, allows the giving of small amounts of anesthetic to maintain the anesthesia on a superficial plane and permits control of respiration in thoracic surgery. The patient wakes up a few minutes after the operation and vomiting with its pulmonary complications are thus avoided or reduced to a minimum.

In thoracic surgery Cecil Gray administers part of the curare before induction of anesthesia; this serves not only to verify the effect of the drug on the patient but also to facilitate endotracheal intubation since laryngeal spasm is eliminated. This technique gives excellent results with any type of endoscopy. Thus when intending to use 15 mgm. of tubarine in adults, 5 mgm. are administered and 3 minutes are allowed for observation of the reaction of the subject. If it is normal the remaining 10 mgm. are injected and the barbiturate is then given. The pulse, heart, and respiration must be constantly watched. Oxygenation in bronchoscopy is easy since the oxygen can be connected with the instrument. Patients wake up at the end of 10 minutes. To shorten the action of curare, 5 mgm. of prostigmine with 0.5 mgm. of atropine are given intravenously.

In prolonged operations, as on the lungs, the best anesthesia consists of nitrous oxide, pentothal, and curare in sufficient dosage to cause apnea. The endotracheal tube and a closed circuit must be used to control respiration. No more than 1.5 gm. of pentothal and 30 mgm. of curare should be used, and 0.1 gm. of pentothal and from 2 to 4 mgm. of



time since the onset. Within 24 hours the pain was entirely gone, and the swelling subsided rapidly during the next few days. A few weeks later a small abscess developed in the cheek. The abscess was opened and in 3 days had completely healed.

One remarkable feature of the emetine therapy was the marked increase of comfort and well-being in at least 4 of the patients, even before objective clinical signs showed a response to treatment.

The dosage of emetine hydrochloride used was 0.03 to 0.05 gm. twice daily with a total of 0.4 to 1.0 gm. necessary to obtain full effect from the treatment. This treatment, with or without ligation, resulted in cures in all 8 cases of malignant lip furuncles reported, even when septicemia was present as indicated by positive blood cultures.

STANLEY W. TUTTLE, M.D.

**Aureomycin.** LOUIS T. WRIGHT, MURRAY SANDERS, MYRA A. LOGAN, AARON PRIOT and LYNDON M. HILL. *J. Am. M. Ass.* 94B, 38 408.

Realizing the need for specific therapy in lymphogranuloma venereum, the authors treated 25 patients with aureomycin a new antibiotic active against many rickettsiae and certain viruses, and not previously used in human beings. Cases were divided into 3 groups: (1) buboes, (2) proctitis and (3) benign rectal strictures.

All patients gave a detailed history and complete physical examinations and extensive laboratory studies were made. The drug was given intramuscularly in daily doses varying from 10 to 40 mgm.

Eight patients with buboes were treated and showed a decided reduction in the size of the nodes at the end of 4 days of treatment. In 3 cases, smears from aspiration of the bubo revealed inclusion and elementary bodies which had all disappeared within 2 weeks after treatment.

Three patients with proctitis were treated and all improved with cessation of rectal discharge, bleeding, and tenderness. After treatment, proctoscopic examination showed normal rectal mucosa.

Fourteen patients with benign rectal stricture were treated. All showed clinical improvement, with decrease in rectal bleeding, discharge, and pain, and an increase in stool diameter. However, no gross pathologic change in the fibrous rectal stricture was apparent.

Aureomycin suspended in isotonic saline solution occasionally produced a mild easily rectified hypochromic anemia. No other toxic effects were noted. Since very small amounts of aureomycin were used in treatment, the amount of circulating antibiotic in the blood was not accurately demonstrable by present methods of assay. S. LYON TETELMAN, M.D.

#### ANESTHESIA

**Balanced Anesthesia for Thoracoplasty.** CLARENCE L. HERBERT. *Anesthesiology* 94B, 9, 537.

The requirements of anesthesia for thoracoplasty include a nontoxic agent giving adequate oxygen,

smooth rapid induction, regular and quiet respiration, a short recovery period, minimal postoperative complications, and nonexplosibility. A form of balanced anesthesia was utilized for the past 3 years at the United States Marine Hospital, Staten Island, New York for 75 patients receiving 177 posterolateral thoracoplasties. The technique is described in detail. Preliminary medication consisted of pentobarbital 0.5 gm. by mouth 1 hour before operation, morphine, 10 to 15 mgm., and scopolamine 0.45 mgm. subcutaneously about 30 minutes before regional block was begun. The technique of paravertebral spinal nerve block is essentially that described by Lundy with the patient placed face down on the operating table and the chest raised on a small pillow. From 8 to 10 cc. of 1 per cent metycaine solution is carefully injected into each of the paravertebral needles, then intravenous pentothal sodium is infused, and a 50 per cent nitrous oxide oxygen analgesia is given and maintained throughout surgery.

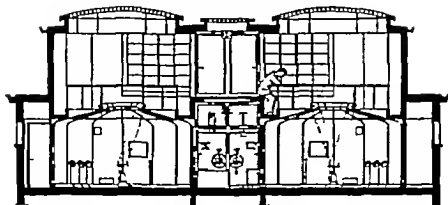
Results of the study indicate that the balanced anesthesia described provides a safe and satisfactory method to meet the special requirements of patients undergoing thoracoplasty. This type of anesthesia is nonexplosive and is therefore suitable for use with an electrosurgical unit. Paravertebral nerve block is a safe procedure in the hands of those trained in regional anesthesia. The incidence of postoperative complications appears to be no greater with this type of anesthesia than with other agents and methods. MARY KARP, M.D.

**Basal Anesthesia in Children, with the Use of Sodium Pentothal by Rectum.** R. W. BURMAN, E. A. GARD and E. H. WATTS. *Anesthesiology* 1948, 9, 574.

For the past 3½ years, anesthesia produced in children with sodium pentothal has been used routinely in the University of Alberta Hospital, at Edmonton (Canada). This technique was used in 300 cases. Its advantages were the avoidance of psychic trauma, especially in cases in which multiple surgical procedures were required, the smooth and rapid gas ether inductions, the rare occurrence of laryngeal spasm, hypoxia, shock, emergence delirium and vomiting, and the absence of disturbance of respiratory rhythm. The main disadvantage was the time required for the anesthetist to go to the ward and give rectal intubation, for it was considered necessary that the patients be watched from the time of administration of the pentothal until they regained consciousness, which increased the nursing care.

Pentothal given by rectum was considered indicated for surgical procedures in children weighing under 75 pounds, and in those over this weight who were unsuitable for venipuncture. By supplementing the basal state with nitrous oxide and oxygen, sufficient analgesia was obtained to reduce simple fractures and to suture lacerations.

The technique was contraindicated in patients who did not have control of the rectal sphincter.



Coupe transversale Y Z

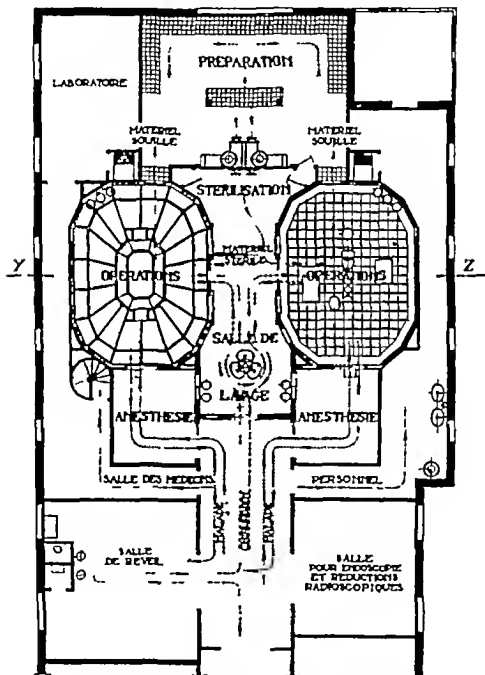


Fig 1 Diagram of the surgical block of Dr. Maumontell

curare are given from time to time. Twenty milligrams of tubarine are enough to obtain paralysis of the diaphragm, the action lasting 40 minutes or more. Naturally reactions vary greatly from individual to individual, as they depend on the condition of the subject and on the length of the operation. There are even patients who respond with excellent muscular relaxation to 5 mgm. of curare.

Curare and cyclopropane have been used in numerous cases of cesarean section with satisfactory results since curare does not depress the child and allows a decrease in the amount of anesthetic used.

As the barbiturates are precipitated with curare, the two drugs should never be administered through the same needle unless some saline solution is passed through it.

The use of curare is contraindicated in myasthenia gravis.

RICHARD KEMER, M.D.

**Effect of Procaine on Liver Function. An Experimental and Clinical Study** J. J. JACOBY, J. M. COOK, M. P. WOOD, P. R. SALZANO, and H. M. LIVINGSTONE. *Anesthesiology* 948, 9-18

Because of the increasing popularity of the intravenous administration of procaine and because the liver seems to be the principal site of detoxification of this drug, these experiments were planned to test the acute and subacute effects of massive doses of procaine on the liver. Rats and dogs were subjected to repeated large but sublethal doses of procaine hydrochloride. Histologic examination of the liver, spleen, heart and kidney of the rats, and liver function tests in all animals revealed no evidence of damage.

Liver function tests following the intravenous administration of procaine to human beings for the control of postoperative pain showed no evidence of liver damage. It appears that the administration of moderate doses of intravenous procaine ordinarily employed for the control of postoperative pain is not harmful so far as the effect upon the normal liver is concerned. A previously damaged liver, however, may respond in a different manner and investigations dealing with this problem are under way.

MARY FRANCES FOX, M.D.

## SURGICAL INSTRUMENTS AND APPARATUS

**Modern Architectural Conception of Operating Room Suites** (Conception moderne des groupes opératoires) F. MASSOUREL. *Rev. chir. Par.* 948, 67-76.

The author begins his article by saying that the architecture of operating suites is being fully revised. The main revision which must be undertaken in all climates is the creation of an atmosphere approaching absolute asepsis. Surgery under the shield of antibiotics is a fortunate, but palliative, conquest. It is better to operate without organisms than with neutralized organisms. Unfortunately for the great majority of surgeons, sterilization of the air in the operating room is

still a problem of secondary importance. For the past 20 years the author has operated in a sterilized atmosphere and he states that major surgery performed in an aseptic operating room has become almost minor surgery as far as infection is concerned. To obtain such asepsis of the air everything must be considered: the disposition of the rooms, their shape, their size, their equipment, and the ventilating system.

The modern operating room must be of restricted dimensions. The ideal dimensions are approximately 6 by 4.5 meters and a 30 meters high, giving a displacement of 60 cubic meters. Deminor has reduced the dimensions to 40 cubic meters. In order that students and visitors may observe a gallery is built above the operating room, with a transparent air tight partition.

The operating room must not open directly on the halls but must be separated from them by an adjoining room, which is used for anesthesia. Moreover the operating room must not serve as a hall to the sterilization room.

The shape of the operating room is not immaterial. While hard to ventilate the elliptical room is to be preferred to the rectangular or circular rooms. The floor of the room must be sloped for drainage and be of a tilelike material and the heat radiation must be outside the room (Fig. 1).

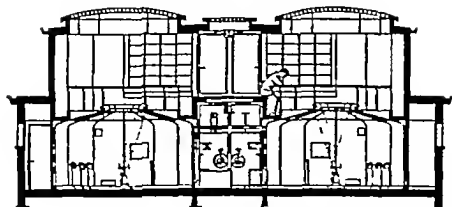
The lighting must be athermanous, and the author recommends that the lighting equipment include a rheostat.

The ventilation has been the subject of extensive studies. The contamination of operating room air comes from two sources: (1) the agitation of the air when the patient is wheeled into the room or when the operating team moves in, and (2) the emission of bacteria from the throat and nose of the occupants. The latter source is the most active and the most difficult to neutralize. The mask interferes with the propulsion of large particles into the operative field, but does not in any way interfere with their diffusion in the atmosphere. To obviate this, the author has devised a ventilating system designed to catch such bacteria at their source and direct them upwards or downwards through air shafts to the filters of the sterilizing machine. For this purpose, in the ceiling are built openings with valves to aspirate the contaminated air while at the periphery of the room are the openings for the entrance of sterilized and conditioned air. The efficiency of this new ventilation is undisputable. The author placed Petri dishes in several places in the operating room and found that the contamination of the air was reduced to 2 and 4 colonies.

The operating rooms should be grouped two by two and should be preceded by rooms for anesthesia.

The sterilizing room should be behind the operating rooms and should communicate with the latter through apertures opening only from the operating room side.

GERARD GAGNON, M.D.



Coupe transversale Y-Z

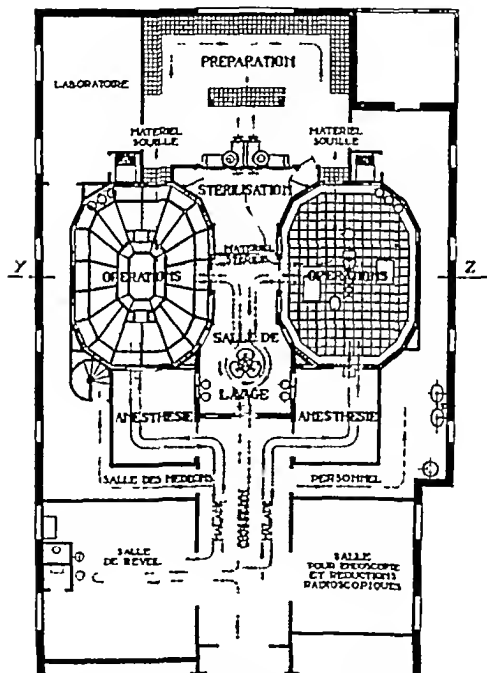


Fig. 1. Diagram of the surgical block of Dr. Massonville

# PHYSICOCHEMICAL METHODS IN SURGERY

## ROENTGENOLOGY

The Roentgen Ray Examination of the Paranasal Sinuses with Particular Reference to the Frontal Sinuses. SÖLVE WILHE. *Brit. J. Radiol.* 1943, 16, 45

Because of the difficulty of clinical examination of the frontal sinuses, the author emphasizes the need for a roentgen technique which will overcome in turn some of the difficulties encountered in the interpretation of roentgenograms of these structures. He presents diagrams and roentgenographic reproductions to show the positions used in sinus radiography at the Caroline Hospital of Stockholm. Most of these are made with a horizontal beam and conform to popular techniques employed in this country but two unusual positions for the frontal sinuses are described in detail.

One of these is a modified submentovertical view which he calls the "overshot axial projection." It is made with a vertical beam, with the head so hyperextended that the region of the frontal bone just posterior to the hairline is in contact with the film-holder thus placing the radiographic baseline at an angle of 40 degrees to the film. This projects the anterior and posterior walls of the frontal sinuses through the maxilla posterior to the symphysis of the mandible. The view is stated as being particularly valuable in comparing the relative thicknesses of the walls of the sinuses on each side. One set of roentgenograms is reproduced, and indicates in the standard projections that one frontal sinus is either bony or its lumen is completely occluded. The overshoot axial view however clearly reveals the appearance to be due to a marked right-left variation in thickness of the walls of the sinuses.

The other unusual projection is essentially a lateral decubitus view with the head in the Caldwell position, the image being projected by a horizontal beam. Convincing illustrations are included, which show how this position, if done with both right and left sides down, will reveal the presence of fluid levels which would otherwise scarcely be suspected. The author describes and illustrates an ingenious little film marker which he states will unfailingly show which side is lowermost in this position. He explains that small amounts of fluid are best visualized in the lateral extent of the frontal sinus in this "decubitus" position whereas if the volume of fluid is large in proportion to the contained air the fluid is best seen collected against the medial septum of the sinuses. The latter view is used only to clarify doubts after routine examination. F. O. W. EYRE, M.D.

Pneumoencephalography in Cerebellar Atrophies. L. UEMAN. *Am. J. Roentg.* 1943, 60: 293

Cerebellar atrophy is usually observed in males of middle age. The most common clinical findings are a

staggering gait with a broad base, and tremor of the head and extremities.

A pneumoencephalogram usually shows slight enlargement of the ventricles of the brain without displacement, the cortical subarachnoid pathways appear to be slightly enlarged, and the basal cisternae are enlarged. Characteristically there is marked enlargement of the cisterna cerebellomedullaris (cisterna magna) an excess collection of air under the tentorium and widening of the cerebellar sulci.

VERN W. RITTER, M.D.

Miliary Calcification of the Lungs: Ecologic Aspects. HOWARD P. DOWN. *Radiology* 1943, 5, 430.

Early writers believed that miliary calcifications of the lungs represented a healed stage of miliary tuberculosis. The author reviews the literature which contributes to this belief. He also reviews the more recent literature indicating that in patients with tuberculin negative miliary calcification, frequently the cause of calcification is either histoplasmosis or coccidiomycosis and both of these conditions tend to exist in endemic areas in the United States. More recently it has been found that *Aspergillus* and *Monilia* may cause pulmonary disease characterized by miliary bilaterally spread lesions.

The author presents the case of a family consisting of a mother and 4 children with chronic respiratory disease which was characterized by miliary lesions. Cultures from bronchoscopy secretions showed *Monilia* in 2 cases, and the others had *Aspergillus* by culture. These cases were followed for 10 years and roentgenograms were made at yearly intervals. All patients recovered completely with smooth, densely calcified miliary lesions of the lungs.

The author suggests that miliary tuberculosis of the lungs may have a similar end result in some instances. Two cases supporting this view are also presented. JANE C. MACMILLAN, M.D.

Idiopathic Pulmonary Fibrosis: Roentgenologic Findings. LAURENCE L. ROSENTHAL. *Radiology* 1943, 5, 452.

Idiopathic pulmonary fibrosis is found in the small group of cases in which no one factor can be found to cause the generalized fibrosis of clinical significance. This, then, excludes inflammatory processes such as tuberculosis, syphilis, and bronchiectasis, also as dilation asthma, pneumoconiosis, and the rarer processes associated with Raynaud's disease, scleroderma, and periarteritis nodosa.

The author presents 16 photographs of roentgenograms of the chest, and on the basis of the fluoroscopic followed by a posteroanterior roentgenogram, with lateral and both obliques when indicated, gives a very definitive discussion of the roentgenological appearance of pulmonary fibrosis. The statement is made that idiopathic pulmonary fibrosis is, as a

rule, a diffuse process. In its early stages, it may not be distinguishable from numerous other processes. In its later stages, the most common roentgen appearance is that of a generalized process with more or less systematically arranged areas of fibrosis interspersed with areas of emphysema. Accurate diagnosis requires correlation of clinical pathologic, and roentgenologic findings.

JANE C. MACMILLAN M.D.

Acute Obstruction of the Small Intestine IRA H. LOCKWOOD, ARTHUR B. SMITH, and JOHN W. WALKER. *Radiology* 1948 51: 310.

The authors correlate the roentgenologic findings and the clinical picture in acute obstruction of the small intestine, and outline a course of successful management. They were induced to do this by the fact that an analysis of 100 consecutive cases revealed that death occurred in no less than 15 in instances, whereas with the exception of one patient all should have been saved.

The management is divided into 5 phases (1) speedy and accurate diagnosis (2) decompression (3) restoration of physiological equilibrium (4) surgery (5) postoperative management

1. If intestinal colic (with borborygmi at the acme of pain) and vomiting are present, and when the abdomen is distended it is imperative that a plain film of the abdomen be obtained immediately. A roentgenogram can give not only the site and degree of the obstruction but often furnishes information regarding the type. In mechanical obstruction a loop (or loops) of gut is distended with gas, the degree of distention depending upon the site of the lesion and the duration and degree of obstruction. In ileus the gas lies in multiple pockets, it stops where it may. In the former the green light is given for immediate surgery in the latter a decompression is recommended.

In conjunction with the mechanical obstruction, the authors stress certain roentgenologic signs which are pathognomonic of gangrene or embarrassment of blood supply of the bowel. One of these signs is the visualization of a smooth-walled tube distended with gas. The picture corresponds to a single loop of bowel distended with gas but which in view of loss of tone and edema has become completely void of its physiological pattern. Another sign has to do with the geometrical pattern of the gut. Single or multiple C-shaped loops of small bowel arising from a common source or pedicle always indicate a volvulus. This pattern is accompanied by a loss of the valvulae conniventes, the extent of which is proportionate to the degree of embarrassment of the blood supply.

The authors consider roentgenography of the abdomen as an absolute emergency day or night. When the examination reveals obstruction of the small bowel, the patient is operated upon immediately. This avoids the phase of distention.

2. When however distention has progressed to the stage at which surgery seems unwise decom-

pression is undertaken. The type of decompression is an age-old controversy. The authors themselves believe that only the Miller Abbott tube should be used and this only as an adjunct to eventual operation. The procedure was resorted to 39 times in the 100 cases of intestinal obstruction with a single failure.

The technique of passing the tube which must be handled by the department of radiology is described in considerable detail. A warning is sounded against overexposure to roentgen rays in inexperienced hands.

3. The restoration of the electrolyte balance of the patient is important. Not only the chloride levels, but also those of the nonprotein nitrogen and particularly in the aged, of the serum proteins must be known. The repeated use of whole blood and plasma preoperatively and postoperatively is necessary to re-establish the electrolyte and protein balance.

4. The technical aspects of the surgical intervention are beyond the scope of the present article. A statistical compilation of the cause of obstruction revealed that postoperative adhesions were to blame by far the most commonly. All patients who died with the exception of one had histories of over 72 hours duration. Gangrene of the bowel and resection contributed greatly to the seriousness of the case.

5. The postoperative management closely follows that used generally. The average hospital stay was 18.5 days, including the period of preoperative intubation.

The article is well illustrated with typical roentgenograms

T. LARSEN, M.D.

On the Roentgen Aspect of Prostatic Cancer on Urethrocytography NILS P. G. EDLUND. *Acta radiol.*, Stockh. 1948 29: 461.

The author reports the findings in urethrocytography in 68 proved cases of carcinoma of the prostate studied at the Caroline Hospital in Stockholm and compares them with the findings in a similar number of cases of benign prostatic hypertrophy, also histologically proved. The two groups of cases covered essentially the same age group—from the middle forties to the middle eighties, with the highest rate of disease in the seventh and eighth decades.

The roentgenograms were made during the injection of water soluble contrast material into the anesthetized urethra at a time when the bladder had begun to fill. Frontal and both right and left oblique views were obtained and in some cases micturition views were attempted.

Study of the films showed that elongation of the prostatic urethra combined with narrowing and irregular deformity of the lumen, abrupt kinking of the luminal course, displacement laterally or anteriorly of the entire prostatic urethra and irregular bulgings into the base of the bladder formed a rather characteristic picture in carcinoma of the prostate. The urethrocytogram may of course fail to show several or all of these signs in spite of good clinical evidence of carcinoma of the prostate. This



Fig. 1. (Edling) Prostatic cancer (hard prostate, osteoplastic metastases in spinal column and pelvis). Displacement of the entire prostatic urethra forward and to the right.

is true particularly of lesions located far posteriorly. Most of the 68 cases of carcinoma, however, showed some change in the urethrocytogram. For example, there was elongation of the prostatic urethra in 66 cases, narrowing of the lumen (mostly supracollicularly) in 43, deformation of the lumen in 63 cases, angulation in 45, displacement of the entire prostatic urethra in 30, and irregular bulging into the base of the bladder in 25.

Elongation of the prostatic urethra also occurred in the cases of benign hypertrophy but was less likely to involve its whole length, and was commonly associated with a ribbonlike compression of the lumen, and in some cases with smoothly curving impressions of the urethra and base of the bladder rather than with irregularly distorted urethral narrowing and kinking as seen in carcinoma. Anterior angulation of the urethra occurred in both conditions but was more pronounced in carcinoma. Lateral displacement of the whole prostatic urethra was seen in nearly half of the carcinoma cases (Fig. 1) but in none of the hypertrophic ones. Trabeculation of the bladder and diverticulum formation occurred with about equal frequency in both conditions and occasionally prostatic calcification and cavity formation were found in both.

The author also found that some cases showed a combination of urethral changes suggestive of the presence of both carcinoma and hypertrophy. While this adds to the difficulty of roentgen differentiation, it is to be expected in some cases since it is not uncommon

for a carcinoma to arise in a hypertrophic prostate. It was noted that the urethrocytographic signs here considered suggestive of prostatic carcinoma could be well imitated by the local changes residual to an electroresection for benign hypertrophy and the author therefore stresses the importance of possessing a trustworthy clinical history before attempting to interpret the films.

Finally, micturition films were obtained in 30 cases of prostatic carcinoma. Sixteen of these showed some decrease in dilatability of the prostatic urethra, but 4 of them showed good dilatability although the injection views gave distinct signs of malignancy. Hence it was concluded that micturition dilatability does not have universal value as an early sign of prostatic cancer.

LILIAN DONALDSON M.D.

#### Irradiation of Pituitary Tumors. H. DARNET KERR. *Am. J. Roentg.* 1948, 60: 348.

The author discusses the diagnosis and irradiation of pituitary tumors. He reports his findings in a follow-up survey of 25 cases presented in 1941 and reviews an additional series of 30 cases.

Adipophilic tumors of the pituitary body are usually suspected because of a disturbance in hormonal growth activity. There is roentgenographic evidence of enlargement or erosion of the sella turcica in about 60 per cent of the cases. The signs and symptoms of chromophobic cell tumors are chiefly headache, visual disturbance, or hypopituitarism, due entirely to pressure on surrounding cells or structures. Usually the rare basophilic adenoma is small; it does not enlarge the sella turcica and causes the well known Cushing's basophilism. It must be differentiated from certain adrenal tumors that produce a similar clinical syndrome.

The author believes that all types of pituitary tumors—adipophilic, basophilic, and chromophobic—should receive primary irradiation. The exceptions are those cases in which it is suspected that the tumor is cystic in type, cases in which there are symptoms suggesting hemorrhage into the tumor or the presence of increased intracranial pressure. Patients who do not show adequate response in 2 months should be operated upon and patients operated upon primarily should receive postoperative irradiation to cause regression of the remaining remnants of the tumor.

Treatment is given using factors of 200 kilovolts, 2.95 mm. of copper half value layer 50 cm. distance, through four 3 cm. circular fields directed toward the sella turcica—2 temporal, 1 frontal, and 1 vertical. A small dose of 100 roentgens is given to one field on the first day and if no reaction ensues, two fields are given 100 roentgens each the second day and from then on 200 roentgens to each of two fields daily to a total of 2,000 roentgens per field (air dose). This delivers approximately 2,400 roentgens into the pituitary fossa in the average sized calvarium.

An over-all good and apparently permanent result in 70 per cent of this series of 55 cases indi-

cases that irradiation is a very satisfactory primary method of treatment. Chromophobous tumors responded as well as the acidophilic type. Although there was a suggestion of possible brain injury in one or two cases following intensive pituitary irradiation there was no proof that such occurred.

JOHN H. FREED, M.D.

Pathology of Pulmonary Fibrosis, Including Chronic Pulmonary Sarcoidosis. TRACY B. MALLORY  
Radiology 1948 51: 468

The author states that in contrast to emphysema pulmonary fibrosis is an uncommon disease having been diagnosed at the Massachusetts General Hospital 59 times in 6000 autopsies as multifocal or generalized involvement of dubious origin. In only 23 of these cases was the severity of the condition of clinical importance.

Widespread fibrosis of the lung interferes with normal pulmonary function by increasing the collagen elasticity of the lung and later with diminished ventilation. With the loss of respiratory function of a large part of the alveolar tissue two conditions develop: (1) a disproportion between thoracic and pulmonary volumes leading to emphysema, bronchiectasis or both; and (2) a decrease in the vascular bed resulting in pulmonary hypertension and cor pulmonale. Pulmonary fibrosis therefore may produce either the symptoms of pulmonary insufficiency or of right-sided heart failure. The reserve factor however is very great.

The most frequent of the pathogenetic types of the condition are (a) bronchial asthma, (b) x-radiation of the chest lesions, and (c) sarcoidlike lesions. A detailed discussion is given of each of these types.

The author states that the incidence of organized pneumonia in patients with chronic bronchial asthma is too high to be a coincidence, and that radiation pneumonitis is complicated by scars of necrotizing pneumonia and healed neoplasia. A progressive form of granulomatous pneumonitis healing by fibrosis is described, and the author's evidence for fibrosing this a form of localized pulmonary sarcoidosis is presented. Ten photomicrographs are included.

JANE C. MACFILLAN, M.D.

Treatment of Deep-Seated Malignant Tumors with Multiple Port Technique Simulating Rotation Therapy. IRA I. KARLSON and SIDNEY L. ETKIN  
Radiology 1948 51: 183.

The authors recommend the use of 12 narrow rectangular portals placed 1 cm apart and girdling the entire chest for irradiation of advanced carcinoma of the esophagus and operable pulmonary neoplasm. By such multiple port technique they believe a homogeneous carcinoacidal dose of 200 kv x-rays can be delivered to the tumor while sparing the skin and peripheral intrathoracic structures to a greater degree than with methods in which fewer portals for cross-firing are employed. The disadvantage of the method is that a large volume of

normal tissue must be irradiated; hence, the tumor dose which can be administered is limited by the total energy absorption which the patient will tolerate.

The location and extent of the tumor is determined by teleroentgenography with the patient in posterior and true lateral positions and then at directly over the center of the lesion. The twelve portals are then outlined on the skin around the chest. Each field must be wide enough for the beam passing through it to cover the whole breadth of the tumor and long enough to extend well beyond the periphery of the gross lesion in order to catch the creepers spreading up and down the wall of the esophagus. Fields 7 by 15 cm were found satisfactory for most esophageal and pulmonary hilar neoplasms. Within these narrow portals the beam must be angled with exactitude to allow cross-fire exactly on the tumor and for accuracy in angling the authors recommend use of the Demy protractor, which also allows easy determination of the tumor-skin distance for each portal. When the esophageal tumor is situated behind the clavicles, projection of the shoulders makes the lateral fields useless. In such cases 1 central portal and 2 to each side of it are placed front and back, giving 10 fields and then 4 portals 5 by 5 cm. in diameter are added at the root of the neck through which the beam is directed slightly downward.

It is assumed from what is known of tumors of histology similar to those of the esophagus that a tumor dose of 5500 to 6500 roentgens delivered within 4 to 5 weeks is the approximate sterilizing dose. The factors used in the cases here reported were 200 kv., 20 ma., 50 cm. distance. Thorax film taken with high voltage layer 1 g. mm. of copper.

Supportive care of the patient is stressed particularly adequate nourishment. Intramuscular administration of 50 mgm. of pyrimidine 1 hour before and again 1 hour after treatment was found very useful in preventing radiation sickness. Weekly blood counts gave the first indication of falling tolerance to large volume irradiation but mild leucopenia developed in only 2 of the 8 cases presented and in spite of large daily doses all patients remained ambulatory during treatment.

The authors report their results with this method in 4 cases of advanced carcinoma of the upper or mid esophagus proved by pretreatment biopsy and in 4 cases of carcinoma of the lung found inoperable at previous thoracotomy. In each of the cases of esophageal carcinoma, the patient's dysphagia was improved within 2 weeks of initiation of treatment and had disappeared by the time treatment was completed. The roentgen appearance of the esophagus greatly improved for its wall became mobile again the rugal pattern linear and only slight narrowing remained to mark the site of lesion. How treatment the first 3 patients developed dyspnea, chills, low grade fever and rales and showed film





Fig. 2. (Zelling) Prostatic cancer (hard prostate, osteoplastic metastases in spinal column and pelvis). Displacement of the entire prostatic urethra forward and to the right.

is true particularly of lesions located far posteriorly. Most of the 68 cases of carcinoma, however, showed some change in the urethrocytogram. For example, there was elongation of the prostatic urethra in 66 cases, narrowing of the lumen (mostly supracollicularly) in 41, deformation of the lumen in 63 cases, angulation in 45, displacement of the entire prostatic urethra in 30, and irregular bulging into the base of the bladder in 25.

Elongation of the prostatic urethra also occurred in the cases of benign hypertrophy but was less likely to involve its whole length, and was commonly associated with a ribbonlike compression of the lumen, and in some cases with smoothly curving impressions of the urethra and base of the bladder rather than with irregularly distorted urethral narrowing and kinking as seen in carcinoma. Anterior angulation of the urethra occurred in both conditions but was more pronounced in carcinoma. Lateral displacement of the whole prostatic urethra was seen in nearly half of the carcinoma cases (Fig. 1) but in none of the hypertrophic ones. Trabeculation of the bladder and diverticulum formation occurred with about equal frequency in both conditions and occasionally prostatic calcification and cavity formation were found in both.

The author also found that some cases showed a combination of urethral changes suggestive of the presence of both carcinoma and hypertrophy. While this adds to the difficulty of roentgen differentiation, it is to be expected in some cases since it is not uncommon

for a carcinoma to arise in a hypertrophic prostate. It was noted that the urethrocytographic signs here considered suggestive of prostatic carcinoma could be well imitated by the local changes residual to an electroresection for benign hypertrophy and the author therefore stresses the importance of possessing a trustworthy clinical history before attempting to interpret the films.

Finally, micturition films were obtained in 20 cases of prostatic carcinoma. Sixteen of these showed some decrease in dilatibility of the prostatic urethra, but 4 of them showed good dilatibility although the injection views gave distinct signs of malignancy. Hence it was concluded that micturition dilatibility does not have universal value as an early sign of prostatic cancer.

LILIAN DONALDSON M.D.

#### Irradiation of Pituitary Tumors. H. DARNET KERR. *Am. J. Roent.* 94:3, 601-348.

The author discusses the diagnosis and irradiation of pituitary tumors. He reports his findings in a follow-up survey of 15 cases presented in 1941 and reviews an additional series of 30 cases.

Acidophilic tumors of the pituitary body are usually suspected because of a disturbance in hormonal growth activity. There is roentgenographic evidence of enlargement or erosion of the sella turcica in about 60 per cent of the cases. The signs and symptoms of chromophobic cell tumors are chiefly headache, visual disturbance, or hypopituitarism, due entirely to pressure on surrounding cells or structures. Usually the rare basophilic adenoma is small. It does not enlarge the sella turcica and causes the well known Cushing's basophilism. It must be differentiated from certain adrenal tumors that produce a similar clinical syndrome.

The author believes that all types of pituitary tumors—acidophilic, basophilic, and chromophobic—should receive primary irradiation. The exceptions are those cases in which it is suspected that the tumor is cystic in type, cases in which there are symptoms suggesting hemorrhage into the tumor or the presence of increased intracranial pressure. Patients who do not show adequate response in 2 months should be operated upon, and patients operated upon primarily should receive postoperative irradiation to cause regression of the remaining remnants of the tumor.

Treatment is given using factors of 500 kRoverts, 1.95 mm. of copper half value layer, 50 cm. distance, through four 5 cm. circular fields directed toward the sella turcica—2 temporal, 1 frontal, and 1 vertical. A small dose of 100 roentgens is given to one field on the first day and if no reaction ensues, two fields are given 100 roentgens each the second day and from then on 50 roentgens to each of two fields daily to a total of 2,000 roentgens per field (air dose). This delivers approximately 2,400 roentgens into the pituitary fossa in the average sized calvarium.

An over-all good and apparently permanent result in 70 per cent of this series of 55 cases indi-

cates that irradiation is a very satisfactory primary method of treatment. Chromophobous tumors responded as well as the acidophilic type. Although there was a suggestion of possible brain injury in one or two cases following intensive pituitary irradiation there was no proof that such occurred.

JOHN H. FREED M.D.

**Pathology of Pulmonary Fibrosis, Including Chronic Pulmonary Sarcoidosis.** TRACY B. MALLORY  
*Radiology* 1948, 51, 468.

The author states that in contrast to emphysema, pulmonary fibrosis is an uncommon disease having been diagnosed at the Massachusetts General Hospital 59 times in 6000 autopsies as multifocal or generalized involvement of dubious origin. In only 23 of these cases was the severity of the condition of clinical importance.

Widespread fibrosis of the lung interferes with normal pulmonary function by increasing the collagen which is associated sooner or later with diminished elasticity of the lung and decreased efficiency of ventilation. With the loss of respiratory function of a large part of the alveolar tissue two conditions develop: (1) a disproportion between thoracic and pulmonary volumes leading to emphysema, bronchiectasis or both; and (2) a decrease in the vascular bed resulting in pulmonary hypertension and cor pulmonale. Pulmonary fibrosis therefore may produce either the symptoms of pulmonary insufficiency or of right-sided heart failure. The reserve factor however is very great.

The most frequent of the pathogenetic types of the condition are (a) bronchial asthma, (b) x-radiation of the chest lesions and (c) sarcoidlike lesions. A detailed discussion is given of each of these types.

The author states that the incidence of organized pneumonia in patients with chronic bronchial asthma is too high to be a coincidence, and that radiation pneumonitis is complicated by scars of necrotizing pneumonitis and healed neoplasia. A progressive form of granulomatous pneumonitis healing by fibrosis is described and the author's evidence for considering this a form of localized pulmonary sarcoidosis is presented. Ten photomicrographs are included.

JANE C. MACMILLAN M.D.

**Treatment of Deep-Seated Malignant Tumors with Multiple Port Technique Simulating Rotation Therapy.** IRA I. KAPLAN and SIDNEY I. ETKIN.  
*Radiology* 1948, 51, 183.

The authors recommend the use of 12 narrow rectangular portals placed 1 cm. apart and girdling the entire chest, for irradiation of advanced carcinoma of the esophagus and inoperable pulmonary neoplasm. By such multiple port technique they believe a homogeneous carcinocidal dose of 200 kv. roentgen rays can be delivered to the tumor while sparing the skin and peripheral intrathoracic structures to a greater degree than with methods in which fewer portals for cross-firing are employed. The disadvantage of the method is that a large volume of

normal tissue must be irradiated; hence, the tumor dose which can be administered is limited by the total energy absorption which the patient will tolerate.

The location and extent of the tumor is determined by teleroentgenography with the patient in postero-anterior and true lateral positions and then at fluoroscopy indicators are fixed front and back directly over the center of the lesion. The twelve portals are then outlined on the skin around the chest. Each field must be wide enough for the beam passing through it to cover the whole breadth of the tumor and long enough to extend well beyond the periphery of the gross lesion in order to catch the creepers spreading up and down the wall of the esophagus. Fields 7 by 15 cm. were found satisfactory for most esophageal and pulmonary hilar neoplasms. Within these narrow portals the beam must be angled with exactitude to allow cross-fire exactly on the tumor and for accuracy in angling the authors recommend use of the Demy protractor, which also allows easy determination of the tumor skin distance for each portal. When the esophageal tumor is situated behind the clavicles, projection of the shoulders makes the lateral fields useless. In such cases, 1 central portal and 2 to each side of it are placed front and back giving 10 fields and then 4 portals 5 by 5 cm. in diameter are added at the root of the neck through which the beam is directed slightly downward.

It is assumed from what is known of tumors of histology similar to those of the esophagus that a tumor dose of 5500 to 6500 roentgens delivered within 4 to 5 weeks is the approximate sterilizing dose. The factors used in the cases here reported were 200 kv., 20 ma., 50 cm. distance Thoracens filtration with high value layer 1.9 mm. of copper.

Supportive care of the patient is stressed particularly adequate nourishment. Intramuscular administration of 50 mgm. of pyridoxine 1 hour before and again 1 hour after treatment, was found very useful in preventing radiation sickness. Weekly blood counts gave the first indication of falling tolerance to large volume irradiation but mild leucopenia developed in only 2 of the 8 cases presented and in spite of large daily doses all patients remained ambulatory during treatment.

The authors report their results with this method in 4 cases of advanced carcinoma of the upper or mid esophagus proved by pretreatment biopsy and in 4 cases of carcinoma of the lung found inoperable at previous thoracotomy. In each of the cases of esophageal carcinoma, the patient's dysphagia was improved within 2 weeks of initiation of treatment and had disappeared by the time treatment was completed. The roentgen appearance of the esophagus greatly improved for its wall became mobile again the rugal pattern linear and only slight narrowing remained to mark the site of lesion. However within 2 to 5 months after the beginning of treatment the first 3 patients developed dyspnea, chills, low grade fever and rales, and showed film

evidence of pulmonary infiltration spreading from the hilum. Within a few more weeks they died, apparently of radiation pneumonitis. In the one case in which an autopsy was obtained the pathologist could find no evidence of residual esophageal neoplasm.

It was evident that some change in the method of administering the treatment must be made. These 5 patients had received tumor doses of 5,800, 6,270, and 8,147 roentgens, respectively in 23 to 30 days, 2 adjacent portals having been treated daily in rotation around the chest, with each portal receiving 600 roentgens in air (750 r with backscatter) per treatment. The daily tumor dose under this method was estimated at 350 roentgens. It was decided that the daily tumor dose could be reduced to 165 to 170 roentgens, each portal receiving only 300 to 360 roentgens in air, and that two opposite portals should be used daily instead of two adjacent ones in order to avoid creation of a hot-spot due to overlapping of beam pathways within peripheral tissue. These changes increased the total treatment time required to achieve the desired tumor dose from just over 3 weeks to about 5½ weeks.

The fourth patient with esophageal carcinoma was treated by this modified method. The depth dose achieved in 35 days was estimated at 6,300 roentgens. This patient made the same initial clinical and roentgen improvement in the esophagus as had the previous patients but so far he had not developed signs of pneumonitis. In the 4 months of observation he had gained 25 pounds in weight and had returned to work.

For the 4 cases of inoperable carcinoma of the lung presented, the girdle distribution of portals had to be modified to allow for the eccentric position of these tumors, 3 of which were in a main stem bronchus, the other in an upper lobe. One patient, a man only 48 years of age, received a tumor dose of 7,539 roentgens in 30 days at the rate of 600 roentgens in air per portal, but the other 3 patients were treated by the modified method recounted above to achieve tumor doses of approximately 6,500 roentgens in a little over 5 weeks. Their chest pain disappeared during treatment, slight weight gain ensued and in each instance the roentgen appearance of the chest became spectacularly improved with only mild pulmonary scarring and pleural thickening remaining visible. At the time of this report 8 months, 7 months, 4 months, and 3½ months, respectively after initiation of roentgen treatment these 4 patients were all working and maintaining their weight.

The authors present this multiple portal technique as one which offers hope of substantial palliation in advanced esophageal and inoperable pulmonary carcinoma provided care is taken to avoid severe radiation pneumonitis. They recognize that the elapsed time is as yet too short to allow evaluation of the possible duration of the palliation or to indicate whether any cure is possible.

LESLIE DONALDSON, M.D.

Observations upon the Lymphopenia of X-Ray Irradiation C. H. G. PRINCE. *Brit. J. Radiol.*, 1948, 21: 48

The author's article is based on cases observed at the University of Bristol and the Bristol Royal Hospital in England. A mathematical correlation was demonstrated between radiation dosage and response of the total lymphocyte count in a group of 16 women receiving a standardized course of pelvic irradiation, in most of the cases for carcinoma of the ovary. All patients were in good general condition, and were free of any clinical evidence of lymph node or bone marrow involvement.

The irradiation factors used were 250 kilovolts, a filter of 1 mm. copper plus 1 mm. of aluminum, giving a high value layer of 1.6 mm. of copper administered through two anterior oblique and one posterior direct pelvic portals at a constant time of day daily for 5 successive days each week, and at a constant daily dose, to achieve a total tumor dose of between 2,800 and 3,300 roentgens for each patient. The pre-treatment level of the total lymphocyte count was first established, and then differential counts were made daily 5 hours after each treatment, using Leishman-stained films of single celled depth. A minimum of 400 cells arranged in battlement distribution along film edges were counted in each film.

From the daily lymphocyte total, mean totals for the 5 day periods were calculated and plotted against time in days, producing in each case a curve showing the greatest change in total lymphocyte count in the initial 14 days of treatment following which the rate of change diminished fairly rapidly to a minor order. For each patient, the curve so obtained was similar.

When curves were re-plotted upon logarithmic graph paper and an attempt was made to fit a straight line to the observed points on the graph, it was found that there was a general tendency for the earlier two or three points to be above the line which best fitted the rest of the values, so that the mathematical expression correlating the total lymphocyte count with the integral dose appeared to be a composite one having the general form  $C = A \cdot 10^{-\frac{1}{2}D} + B \cdot 10^{-\frac{1}{2}D}$  where C = percent survival of total lymphocytes for values of D, A = a proportion of the total lymphocyte count which appeared to diminish less rapidly than the component  $10^{-\frac{1}{2}D}$ , B =  $100 - A$ , and  $\frac{1}{2}D$  = indices representing the rate of diminution of the two components A and B, D = integral dose in megastems.

The values for all of these functions were calculated for each of the 16 cases. It appeared that the value of component B in the integral dose curves was mainly responsible for the major change in total lymphocyte count that takes place during the early days of a course of treatment. The author suggests that this component may represent the result of the direct action of the radiation, and that the further but smaller drop in lymphocyte count represented by component A may be due to an indirect action of radiation. After several weeks a stage is reached at which further irradiation, at the level of dosage used

in these cases, causes only a very small change in lymphocyte count.

Clinical assessment of tolerance (good, fair or poor) to x irradiation revealed no correlation between age, initial or final lymphocyte count, the rate of change of total lymphocyte count, the total dose of radiation, or the rate of dosage. The author therefore concludes that the total lymphocyte count from a quantitative point of view is not a good index of tolerance to radiation, although its characteristic pattern of change under standardized conditions of fers an approximate index of the degree of radiation dosage.

LILLIAN DONALDSON M.D.

### MISCELLANEOUS

**Radioactive Iodine: Its Use as a Tool in Studying Thyroid Physiology** RULON W. RAWSON and BENGT N. SKARER. *Radiology* 1948, 51 525

Three types of radioactive iodine have been used in the study of thyroid function.  $I^{131}$  with a half life of 25 minutes,  $I^{132}$  with a half life of 12 hours and the more practicable  $I^{131}$  with a half life of 8 days.

The earliest studies in 1938 by Hertz and others showed that hyperplastic thyroids concentrated a greater percentage of radioactive iodine than the normal controls.

Anatomical changes in the thyroid have also been studied. The first changes observed in an animal receiving thyroid stimulating hormone were hypertrophy of the thyroid cell and a loss of thyroid iodine.

Oral radioactive iodine is rapidly absorbed by the gastrointestinal tract and is demonstrable in the thyroid within 20 minutes. Most of the material (80%) is excreted during the first 5 days in urine. Hypothyroid patients collect very little iodine. Myxedematous patients excrete from 85 to 90 per cent of the iodine in the first 24 hours. The excretion rate is slower than in normals.

Benign tumors collect iodine whereas malignant thyroids do not collect radioactive iodine. In those cases of thyroid cancer in which the primary tumor was removed surgically or was destroyed by radioactive iodine the sites of distant metastases were shown to have a definite affinity for iodine.

The studies carried out by these authors indicate a definite need for determining the minimum tracer dose so that there may be no interference with normal thyroid function. MAURICE D. SACHS, M.D.

**Treatment of Hyperthyroidism with Radioactive Iodine ( $I^{131}$  12 Hour Half Life, and  $I^{131}$  8 Day Half Life)** EARLE M. CHAPMAN, BENGT N. SKARER, and RONLEY D. EVANS. *Radiology* 1948, 51 558

The authors treated 65 hyperthyroid patients between 1943 and 1947 with radioactive iodine having a half life of 12 hours isotope  $I^{132}$ . Between August, 1946 and the present time another 65 were treated with 8-day isotope  $I^{131}$ . Radioactive iodine  $I^{131}$  with a half life of 12 hours has been used effectively alone in a single retained dose averaging 20 millicuries per estimated gram of thyroid 90 per cent of whose

radiation dose is delivered in the first 36 hours. Myxedema has been produced. The histologic changes seen in the thyroids 1 and 2 years after treatment show fibrosis and regenerative hyperplasia according to the unanimous judgment of 5 pathologists. Relapse or recurrence of hyperthyroidism has not been observed. Toxic effects of this short lived form of radioactivity have been nausea, slight fever and swelling and tenderness of the thyroid for a few days. Effective doses in the second and fifth months of pregnancy have not caused cretinism. Radioactive iodine  $I^{131}$  with a half life of 8 days is an effective single therapeutic agent. In 41 of the patients who responded the average retained dose was 0.142 millicuries (142 microcuries) per estimated gram of the thyroid tissue. 97 per cent of this dose of radiation is delivered in 30 days. In most cases the administered effective dose was from 8 to 14 millicuries by mouth. Myxedema has been produced in only 4 cases. The only histologic study as yet available is from a gland removed at autopsy only 19 days after treatment. The gland shows edema and separation of the cells from the basement membrane but no fibrosis. Toxic effects of treatment with the 8-day isotope may be related to an exacerbation of the thyrotoxicosis that sometimes occurs in the first 1 or 2 weeks following treatment during which time the release of stored thyroid hormone may be reflected in the rising blood protein bound iodine.

FRANK L. HUSKEY M.D.

**Radioactive Iodine Studies of Functional Thyroid Carcinoma** VIRGINIA KIMBLELAND FRANK, Editor H. QUINBY and TITUS C. EVANS. *Radiology* 1948 51 532

In 1940 Hamilton Foley reported the results of his studies on the deposition of radioactive iodine in human thyroid tissue. The article was accompanied by radioautographs of two thyroid carcinomas which failed to take up radioactive iodine. Foley concluded therefore, that it was inadvisable to treat such lesions with radioactive elements. However since there are different types of thyroid cancer it is still possible to consider the treatment of these lesions.

A 20 year study (1924-1944) of 4,707 thyroids revealed 151 cases of cancer. Three fourths of 139 primary cancers of the thyroid studied up to June 1, 1947 were slow growing lesions with late metastasis. In this group the papillary and adenomatous or follicular, types of lesion were equally divided. Papillary lesions are multiple with local invasion and they metastasize to the lymph nodes and lungs, but not to the bone. The adenomatous or follicular type of tumor appears to be benign histologically, usually occurs singly is encapsulated with spread to the bone (not to the lymph nodes) and to the lungs only late in the disease.

All patients with thyroid enlargement in whom malignancy is suspected receive a presurgical tracer dose of radioactive iodine. thyroid uptake and urine output are measured. At the time of surgery the gross specimen is examined *in situ* by the surgeon

and pathologist. The type of surgical procedure is then determined. Portions of the tissue are measured directly with the geiger counter and radioautographs are taken if necessary.

Up to May, 1943 a total of 63 potential carcinomas of the thyroid had been studied with tracer doses of  $I^{131}$ . Of these, 33 were benign (26 nodular goiters, 4 inflammatory and 3 adenomas). Of the thyroid cancers, the undifferentiated grades II and III showed no uptake of radiiodine. Of 8 malignant adenomas, 7 showed uptake in bone metastases. Fifteen tracer studies for metastasis were made. Studies were made also at the time of operation to determine the efficacy of total thyroidectomy.

The present work is a preliminary study accompanied by excellent radioautographs showing the uptake of radiiodine in tissue. With regard to future plans, the authors state that in the cases of malignant adenomas with bone metastases and multiple tumors in the lateral neck, with or without involvement of the gland treatment will consist of thyroidectomy, followed by from 50 to 100 mc. of radiiodine for bone metastases if necessary. Patients with multiple lesions in the neck will receive a smaller prophylactic dose of radiiodine postoperatively. In most instances operative treatment is preferable to radiiodine for total removal of the thyroid. Radiiodine therapy is believed to be too time-consuming.

MARGARET D. SARVER, M.D.

**Factors Involved in the Experimental Therapy of Metastatic Thyroid Cancer with  $I^{131}$**  L. D. MARSHALL, J. B. THORNTON, R. F. HILL, and F. W. FOOTE. *Radiology* 94:5, 535.

The treatment of metastatic cancer of the thyroid by radioactive iodine presents features of interest and importance. Efforts to localize radioelements in neoplastic cells have been made but thus far a concentration of practical value has not been obtained. The experience gained in the last decade in the treatment of hyperthyroidism with  $I^{131}$  or  $I^{129}$  cannot be utilized fully in the treatment of cancer of the thyroid. In the case of hyperthyroidism, remission of symptoms is sought by partial inactivation of the thyroid gland, whereas in the case of cancer radical devitalization of extensive tumor masses is attempted under conditions of differential uptake which, as a rule, are not as favorable.

In the course of the past year, 18 patients have been investigated to determine their suitability for treatment with  $I^{131}$ . In all of them metastases were present. The authors present one case in which satisfactory initial retention of  $I^{131}$  in the tumor warranted immediate experimental therapy with massive doses. The patient had a primary tumor excised in 1941. A month later multiple bone metastases appeared. In 1944, it was found that the lesions concentrated  $I^{131}$ . Due to a lack of availability of isotopes in large quantities, the treatment was not begun until 1946. Two days after a small tracer dose, 60 millicuries of radiiodine  $I^{131}$  were given orally and 7 days later a larger dose of 122 millicuries was

given orally. Definite improvement followed. Soon afterward however an acute thyrotoxicosis developed. The hypothesis was advanced that under the influence of intracellular radiation the thyroid follicle cells of the tumor had broken down thereby releasing large amounts of thyroglobulin in the organism. A blood specimen taken at this time verified this hypothesis. The report of 36 micrograms of protein bound iodine per 100 c.c. of plasma confirmed the suggested mechanism. The thyrotoxic symptoms cleared and the patient developed a carcinoma of the larynx which was treated by roentgen rays. Thyrotoxic symptoms reappeared on resuming isotope therapy. Propylthiouracil was administered for 76 days in an attempt to empty the tumors of their stored thyroglobulin. A dose of 122 millicuries of radioactive iodine was given at this time with no reaction of any kind. The patient has shown much improvement having gained 55 pounds of weight, and he is able to drive his own car.

Preliminary results warrant further clinical trial of this type of therapy. FRANK L. HICKEY, M.D.

**Cancer of the Cervix Uteri.** JOHN F. HIXSON. *Am. J. Surg.*, 94:5, 602, 603.

This report consists of an analysis of 196 consecutive cases of cancer of the cervix uteri referred for treatment during the period from 1935 to 1944. A combination of roentgen and radium therapy with occasional supplementary intravaginal cone therapy was used and the method is described. The radiation treatment is carried to the maximum tolerance level, and the total treatment is given in from 6 to 8 weeks. Unnecessary treatment to surrounding normal parts should be avoided. When indicated, supportive therapy is used to improve or maintain the general health of the patient and to reduce the frequency of radiation sickness.

The Schmitz classification is used in the staging of the disease and lesions classified as stage 1 and stage 2 are considered operable.

The results are based on an analysis of 203 determinate cases. This includes all previously untreated lesions in patients who received treatment in this clinic, except 8 cases in patients dying of unrelated intercurrent disease and 1 case which was lost to follow-up when the patient was free of disease for more than 3 years. These 9 cases are classified as indeterminate along with cases which recurred after treatment elsewhere. Cases in patients referred but not treated, and cases seen only in consultation.

The relation of survival to stage of the disease, age and race of patients, and duration of symptoms is tabulated. A relatively high incidence of associated syphilis is reported but this did not appear to influence the prognosis nor the response to treatment. The various complications following radiation therapy are recorded and discussed. A 3 year survival of 57 per cent of all cases and of 75 per cent of operable cases, and a 5 year survival of 51 per cent of all cases and of 71 per cent of operable cases are reported.

JOHN H. FIKES, M.D.

**Effects of Radiation on Hemopoiesis.** JOHN S. LAWRENCE, ANDREW H. DOWDY and WILLIAM N. VALENTINE. *Radiology* 1948 51 400.

The authors present the observations of the various members of the Manhattan Project relative to the effects of radiation on the hemopoietic tissues. In considering the effects of radiation of hemopoiesis the following facts should be recognized. The cells in the blood are relatively resistant to radiation. The peripheral blood picture produced by radiation is affected markedly at any one period following irradiation by the length of life of the different morphological elements in the peripheral blood. The effect of radiation on the peripheral blood picture is influenced by radiosensitivity of the various parent cells. The ability of the tissues to regenerate is of great importance.

The most worthwhile observations of the effects of roentgen radiation applied to the body as a whole have been made on animals. In one study a large series of rats was used. These were divided into groups receiving different amounts (25 to 1500 roentgens) of irradiation in single doses, and the findings in the animals were followed closely for 25 days. In another large series of rats 550 roentgens were given to the whole body and blood studies were made at frequent intervals up to 41 days. Little change was noted in the red blood cells receiving 200 roentgens or less. Questionable changes occurred in the group receiving 300 to 500 roentgens during the first 168 hours. There was however appreciable reduction in both erythrocyte and hemoglobin levels between 168 and 448 hours. In animals receiving 600 to 800 roentgens significant drops in both erythrocytes and hemoglobin were present at 168 hours also in the series given 550 roentgens to the whole body a precipitous drop in red blood cells and hemoglobin levels occurred. Reticulocytes were not reduced when less than 200 roentgens were used. Marked reductions however, occurred with dosages of 200 to 500 roentgens, beginning at 72 hours and persisting for 120 hours in the animals receiving 200 roentgens and for 180 hours in those receiving 500 roentgens. Regeneration of reticulocytes became apparent at 168 to 180 hours in the groups receiving 600 to 800 roentgens. No significant changes in platelets were noted in those receiving less than 200 roentgens. Platelet reduction occurred in the rats receiving 300 to 500 roentgens after 120 to 168 hours. In rats receiving 500 to 800 roentgens platelet reduction occurred by the fifth day. From 70 to

90 per cent of the leucocytes in the normal rat are lymphocytes. No unquestionable changes occurred in the neutrophils until dosages greater than 100 roentgens were used. A dosage of 25 roentgens was found to cause a drop in the lymphocyte level in 24 hours. It was found that the lymphocytes exposed to 550 roentgens were reduced as early as at 15 minutes after irradiation. With a single dose of 550 roentgens the effects of radiation injury in the lymph nodes were present at one hour after irradiation. At 6 hours after irradiation cytolysis of the cells in the lymph follicles had reached its maximum and the cellular debris was rapidly being removed by macrophages. Twenty four hours after irradiation regeneration and repair of the lymph nodes were actively progressing and by the twentieth post irradiation day regeneration was complete. It should be noted that the findings in the lymph nodes did not show good correlation with the peripheral blood picture since the total number of the lymphocytes in the peripheral blood at the end of 25 days was still appreciably below normal. The changes in the spleen after irradiation followed closely those observed in the lymph nodes except that the whole process was somewhat more prolonged.

Regeneration was first observed between the thirtieth and the thirty fifth hours after irradiation and was not complete until 40 days after exposure. Cellular destruction in the bone marrow reached its maximum between 2½ and 5 hours after irradiation. Most of the accumulated cellular debris was removed by the thirtieth postexposure hour. By the eighth day hypoplasia was very severe, but at no time was complete aplasia observed. Active regeneration began approximately 12 days after irradiation and was completed on the fortieth day. The greatest reduction in the megakaryocytes occurred between the fourth and twelfth days after which regeneration began.

Experimental studies on animals exposed repeatedly to small doses of roentgen and gamma radiation are more difficult to summarize. In every species studied a daily exposure of 10 roentgens per day resulted in detectable change in some of the hemopoietic elements within a year's time. Observations as to local area irradiation point to the fact that hemopoietic tissue not in the area exposed is not affected. The purpose of all of the studies which have been reviewed is to get a better idea of the effect of radiation on man.

FRANK L. HUSSEY M.D.

## MISCELLANEOUS

### CLINICAL ENTITIES—GENERAL PHYSIOLOGICAL CONDITIONS

**Precocious Puberty (Pubertas precoxa).** J M CARA  
DELL, A SICARDI and L. E. TERRADES *Acta  
endocr* 94, 27

Precocious puberty has many symptoms all of them referring to an exaggerated, earlier than normal sexual development. Along with this are the secondary changes which usually follow such as quality of voice and distribution of hair. The etiopathogenesis permits classification into (1) constitutional, (2) endocrine and (3) cerebral groups. The last includes those cases which are of a meningo-encephalic, hydrocephalic, or of intracranial tumor origin. The constitutional type is the most frequent of the three examples which are reported.

The first was a case of hypothalamohypophysis anomaly which demonstrated the characteristic findings of sexual alterations hypogonadism hyperostosis of the frontal bones, angiomatous nevi and obesity. These changes were placed on familiar and hereditary bases. The second case revealed obesity alterations of the sella turcica, and ovarian hypofunction and the third showed the usual morphologic changes and the presence of active gonadotropic and estrogenic substances but there was no progesterone obtainable. Cyclic menses with ovulation resulted. The fourth case of suprasellar hyperfunction associated with neoplasm of the left gland is described as an example of the endocrine type, which also included pineal body suprasellar, and other gonadic dysfunctions. Extremely high elimination of 17-ketosteroids characterized this last case.

STEPHEN A. ZIEGLER, M.D.

**Hypervitaminosis A. Report of 3 Cases in Infants.**  
FRANZ E. ROYERMAN and E. ELIZABETH LEON  
*Pediatrics* 94, 5, 368

The current popularity of vitamin preparations requires the physician to be alert for signs of overdose. Two cases of hypervitaminosis A in infants over one year of age are presented by these authors. In each child the daily intake of vitamin A was estimated to be in excess of 100,000 international units.

The salient clinical features include a history of excessive intake of vitamin A preparations, anorexia with failure to gain weight irritability bone sensitivity sparse hair, cracking of the lips, hepatomegaly and generalized pruritus. Roentgenographic examination shows evidence of periosteal proliferation, most common in the ulna. Increased vitamin A and carotene levels in the blood are further diagnostic aids. In one child a yellowish tinge to the skin was present.

The treatment consists of discontinuing vitamin A preparations and the reduction of foods containing a high content of vitamin A. Both patients responded

clinically to this treatment in 10 to 24 days, although the blood levels of carotene and vitamin A did not fall to normal for several months.

A similarity exists between bone changes in infantile cortical hyperostoses and hypervitaminosis A. The former differs clinically in the absence of a history of excessive intake of vitamin A, the presence of fever a subacute course with recurrences, and onset usually before the age of one year. The periosteal reaction in infantile cortical hyperostoses involves principally the mandible and frequently a lamellated appearance is seen in the film indicative of the recurrent course of the disease.

According to the authors, the huge capacity of the liver to store vitamin A rarely necessitates the administration of vitamin A in excess of 5,000 international units. A bibliography of experimental and clinical studies on vitamin A is presented.

JAMES L. BRILL, M.D.

**Clinical and Experimental Study of Thyroid-Inhibitory Substances. Comparative Experimental Study of 31 in Derivatives of Thiourea (Kienke diuibe a sperimentali sulle sostanze tiroinibitrici Studio sperimentale comparativo sui principali derivati tioureici).** LUCIO PARONI and MAURO DE GURGO *Arch Ital Biol* 1943, 70, 199.

In addition to thiourea, the following substances have been investigated in regard to their inhibitory effect on hyperthyroidism derivatives of the aliphatic series such as diethylthiourea and thioisomane, derivatives of the aromatic series, such as phenylthiourea derivatives of the heterocyclic series, such as thioracil, methythioracil, aminothiazole, thioisobaric acid, aminothiodiazole and aminoethylthiodiazole.

The authors studied the effect of thioracil methythioracil, and aminothiazole on the histologic structure of the thyroid gland, hypophysis, thymus, and other organs and the peripheral and medullary blood, and made histochemical determinations of glycogen in the liver and of calcium, sugar nitrogen, cholesterol, fibrinogen and prothrombin in the blood.

The experiments were performed on albino mice guinea pigs and dogs. The goitrogenic effect was estimated by calculating the ratio of the thyroid gland removed at the autopsy to the body weight of the animal.

Two classes of phenomena produced by thyroid-inhibitory substances may be distinguished initial changes (the intensity being in proportion to the dose of the drug) which are the result of the toxic-necrotic effect of the substance administered, and later changes which are, to a certain degree, independent from the entire dose and due to the specific inhibitory effect of the substance on the thyroid gland.

During the first 2 to 5 days after the beginning of the experiment the following changes take place in the thyroid gland: hyperemia of the glandular tissue, nuclear pyknosis, desquamation of the follicular epithelium and the appearance of hemorrhagic and necrotic-degenerative foci. Later on a liquefaction and absorption of the colloid substance and hypertrophy and hyperplasia of cellular structures of the follicular epithelium take place.

The greatest sensitivity to the substances studied was found in mice, then in guinea pigs and dogs. The smaller the regressive changes the greater the intensity and rapidity of the appearance of hypertrophy and hyperplasia. The regressive lesions were more pronounced after administration of aminothiazole than after thiouracil or methylthiouracil.

The goitrogenic effect of methylthiouracil was stronger than that of thiouracil while aminothiazole had the weakest effect.

Thyroidinhibitory substances produce a deficiency of thyroxin with a resulting compensatory increase of the secretion of thyrotropic hormone by the anterior lobe of the pituitary gland. This hormone stimulates the thyroid gland in an abnormal manner so that vacuolization and absorption of the colloid substance, and hypertrophy and hyperplasia of the follicular epithelium take place.

The authors were not able to detect any histologic modifications in the hypophysis. The following changes were noticed in the blood: diminution of hemoglobin and in the number of red and white blood corpuscles, neutropenia, and relative lymphocytosis. The examination of the bone marrow did not show any changes. The sugar and nitrogen contents of the blood fell. This was probably due to a diminished metabolic activity. The amount of cholesterol in the blood increased in the course of the experiments. JOSEPH K. NARAT, M.D.

#### The Relationship Between Heparin Dosage and Clotting Time. L. B. JACQUES and ARNOLD G. RICE. *Blood* 1948 3 1197

The authors have studied the effect of heparin dosage on the clotting time in the dog, both in vitro and in vivo. It was found that the clotting time reached a maximum in 5 to 15 minutes after the intravenous injection of moderate doses of heparin and that this maximum clotting time was greater than that occurring when the same amount of heparin was added to the blood in vitro, because of the increased anticoagulant effect of heparin which is incubated with blood. Clotting times returned to normal after short intervals and were constant with given dosages.

The clotting time response to certain concentrations of heparin added to the blood in vitro was considered a measure of the sensitivity of the clotting system to heparin. The clotting time response to a fixed dose of heparin injected intravenously was considered a measure of the body's ability to remove heparin from the circulation when interpreted in the light of the in vitro response.

This test was then used on animals subjected to anesthesia with pentobarbital, ether or urethane the injection of India ink (reticuloendothelial blockade) removal of both kidneys and removal of the gastrointestinal tract. The results indicated that neither the reticuloendothelial system, the kidneys nor the gastrointestinal tract were involved in the disappearance of heparin from the circulation since none of these procedures had any effect on the duration of heparin action in the body.

When the sensitivity of the blood to the anticoagulant action of heparin was tested, pentobarbital and nephrectomy had no effect, ether caused an increase in sensitivity and urethane, India ink and evisceration caused a decrease. Coagulability of the blood was decreased by pentobarbital, increased by India ink and evisceration, and little affected by urethane, ether or nephrectomy.

S. LLOYD TRITELMAN, M.D.

#### Circulating Anticoagulant as a Cause of Hemorrhagic Diathesis in Man. C. LOCKARD CONLEY, HOWARD K. RATHBUN, WILLIAM I. MORSE, II, and JAMES E. ROBINSON, JR. *Bull. Johns Hopkins Hosp.*, 1948 83 188.

The hemorrhagic syndromes are generally explained on the basis of a deficiency of one of the plasma components necessary for coagulation. While this may be true in a majority of cases, the authors present evidence to show that abnormal bleeding may be due to the spontaneous occurrence of an anticoagulant in the blood.

Three cases of abnormal bleeding are presented, with clotting times of 68 minutes, 60 minutes, and 5 hours. The last is a hemophilic, but neither of the other cases showed any laboratory findings to explain the increased clotting times. All three cases were found to have circulating anticoagulant by the following procedure. Fresh, whole blood from each case was centrifuged and the supernatant plasma was found to be free of platelets and remained clot free indefinitely. When small amounts of this plasma were added to portions of normal blood, the coagulation time of the latter was prolonged, indicating the presence of some anticoagulant in the plasma specimens. Similarly prepared plasma from normal persons or from unaffected hemophiliacs had no effect on the clotting time of normal blood.

Studies were made to determine the nature of these anticoagulants. Toluidine blue and protamine, which counteract the effect of heparin in normal blood, had no effect on the clotting times of these patients. So it seems that the unknown clotting inhibitors are not related to heparin. Assays revealed normal values for proteolytic enzyme and proteolytic enzyme inhibitor in all 3 patients. The anticoagulant was apparently unaffected by heat at 65 degrees centigrade for 5 minutes.

Plasma mixtures containing measured amounts of thrombin and the plasma under study were prepared and subsequent thrombin times showed no variation from controls. This suggests that the anticoagulant



## MISCELLANEOUS

### CLINICAL ENTITIES—GENERAL PHYSIOLOGICAL CONDITIONS

**Precocious Puberty (Pubertad precoz)** J. M. CARABELL, A. SECARELL and L. E. TERRADES. *Act endocr exp* 61:3 7

Preocious puberty has many symptoms all of them referring to an exaggerated earlier than normal, sexual development. Along with this are the secondary changes which usually follow such as quality of voice and distribution of hair. The etiopathogenesis permit classification into (1) constitutional, (2) endocrine and (3) cerebral groups. The last includes those cases which are of a meningoencephalic, hydrocephalic, or of intracranial tumor origin. The constitutional type is the most frequent of the three examples which are reported.

The first was a case of hypothalamohypophysis anomaly which demonstrated the characteristic findings of sexual alterations: hypogonadism by perostosis of the frontal bones, acromegalic nose and obesity. These changes were placed on a familial and hereditary basis. The second case revealed obesity alterations of the sella turcica, and ovarian hypofunction and the third showed the usual morphologic changes and the presence of active gonadotropic and estrogenic substances, but there was no progesterone obtainable. Cyclic menses with ovulation resulted. The fourth case of suprarenal hyperfunction associated with neoplasm of the left gland is described as an example of the endocrine type, which also included pineal body suprarenal, and other gonadic dysfunctions. Extremely high elimination of 17-ketosteroids characterized this last case.

STEPHEN A. ZIDMAN, M.D.

STEPHEN A. ZIGMAN, M.D.

Hypervitaminosis A. Report of 2 Cases in Infants.  
PHILIP E. ROTHMAN and F. ELIZA STEIN LEON.  
*Radiology* 94:5, 168

The current popularity of vitamin preparations requires the physician to be alert for signs of overdose. Two cases of hypervitaminosis A in infants over one year of age are presented by these authors. In each child the daily intake of vitamin A was estimated to be in excess of 100,000 international units.

The salient clinical features include a history of excessive intake of vitamin A preparations, anorexia with failure to gain weight, irritability, bone sensitivity, sparse hair, cracking of the lips, hepatomegaly and generalized pruritus. Roentgenographic examination shows evidence of periosteal proliferation, most common in the ulna. Increased vitamin A and carotene levels in the blood are further diagnostic aids. In one child a yellowish tinge to the skin was present.

The treatment consists of discontinuing vitamin A preparations and the reduction of foods containing a high content of vitamin A. Both patients responded

clinically to this treatment in 10 to 24 days the blood levels of carotene and vitamin fall to normal for several months.

A similarity exists between bono chagrite cortical hyperostoses and hypervit. The former differs clinically in the absence of excessive intake of vitamin A. The fever, a subacute course with recurrence usually before the age of one year. The action in infantile cortical hyperostosis principally the mandible and frequently appearance is seen in the film, indicative of recurrent course of the disease.

According to the authors, the huge c  
liver to store vitamin A rarely necess  
ministration of vitamin A in excess of  
tional units. A bibliography of exp  
clinical studies on vitamin A is presen

**TOWN 1**

**Clinical and Experimental Study of  
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Study of Main Derivatives of Th  
cliniche e sperimentali sulle sost  
Studio sperimentale comparativo  
vati (torricelli) L'Espresso PARODI and  
0081 Arch Ital Sci 1918; 70:1**

In addition to thiourea the following have been investigated in regard to their effect on hyperthyroidism: aromatic amine derivatives, such as diethylthiourea; aliphatic amines, derivatives of the aromatic series, such as phenylthiourea; derivatives of the heterocyclic series, such as thiazole, methylnitrothiourea, thiobarbituric acid, aminothiodiurea, ethylthiodiazole.

The authors studied the effect of yithiouracil, and aminothiazole structure of the thyroid gland, and other organs and the periparturient blood and made histochemical glycogen in the liver and of calcitonin, fibrinogen and blood.

The experiments were performed on guinea pigs, and dogs. The results were estimated by calculating the percentage of gland removed at the anteroposterior end of the animal.

Two classes of phenomena inhibitory substances may be chosen (the intensity being dose of the drug) which a toxic-necrotic effect of the a and later changes which are dependent from the entire d elic inhibitory effect of the s land.



does not act by an antithrombic mechanism. Similar mixtures with controlled prothrombin content showed similar results except that one patient (not the hemophilic) who had had a slightly prolonged prothrombin time clinically showed a persistence of this finding. Thus, the prolonged prothrombin time of this individual was apparently due to the unknown anticoagulant in his blood.

With the addition of adequate thromboplastin the plasma specimens clotted immediately and while lesser concentrations of thromboplastin had varied effects, it seems that the anticoagulant may act by preventing the formation of thromboplastin in some way.

Several cases of atypical hemorrhagic syndromes are reviewed from the literature and it is suggested that many of these may have been caused by circulating anticoagulants such as are reported here. Anticoagulant assays of all blood exhibiting prolonged clotting times will likely reveal many more such cases. No therapy is known for this condition.

STANLEY R. TUKILL, M.D.

**Ichthal Decubitus Ulcer** EURETT BOSS and A. ESTIN  
*COMA & Surgery* 94:3, 4 650

This article summarizes the author's experience with 47 ichthal decubitus ulcers in 41 patients on a paraplegic service. These ulcers were not dependent upon the nutrition of the patients nor did they appear to be related to the level of the spinal cord lesion. The sore-free interval varied greatly from 3 months to 13 years, after which the local trauma of weight bearing pressure broke the urine-moist skin. Atrophy of the gluteal muscles and absence of adequate soft tissue between skin and ichthal tuberosity were believed to be contributing factors.

Systemic preoperative preparation consisted of the correction of hypoproteinemia and avitaminosis, liberal transfusions of whole blood and the administration of both penicillin and sulfonamides. Local treatment of the wound consisted of simple débridement.

Operative treatment of the simple ulcer with burna formation was confined to excision, with suturing of a protective layer of gluteus maximus muscle over the tuberosity and closure of the skin margins. For the more frequently encountered deep ulcer which had involved the bone, removal of the ulcer and bone en bloc was performed. Two methods of closure were then employed. In one (the "primary method") redundant gluteal musculature was pulled over the bone defect by means of stainless steel wire sutures. In the "secondary method," a medially pedicled flap of gluteal muscle was brought down over the bony prominence. In both procedures steel wire was used to close the skin, and the wounds were drained. Fluff gauze pressure dressings were applied and partial immobilization was achieved by the use of an Ace bandage spica.

With this type of treatment cures were effected in 85 per cent of the cases. One operation was sufficient in 66 per cent of the patients. In another 19

per cent, success was achieved after more than one intervention. Comparison of the rates of recurrence and of numbers of cases requiring more than one operation makes the "secondary method" seem slightly more desirable. Of the 7 failures (15 per cent of the series) the first one may be attributed to faulty interpretation of roentgenograms wherein the bone changes were unrecognized and hence untreated. A second failure resulted from a series of unfortunate postoperative incidents. A third patient, whose repair failed to hold, had a proctitis and set up for unduly long periods during the healing of the wound. Two other patients also sat for unduly long periods, driving their cars. A sixth patient developed a postoperative hematoma in spite of the use of drains in the wound. The seventh patient left the hospital on an emergency leave before the scar had become stable.

The authors advocate early use of braces and thorough instruction of the patients as prophylaxis against the development of ulcers.

BENJAMIN F. LOUGHEURTY, M.D.

**Skin Lesions Due to Pitch and Tar** PHILIP ROSE  
*Brit. M. J.* 94:3, 369.

The widespread use of tar and pitch for various industrial purposes has led to an appreciable incidence of skin lesions among workers who repeatedly handle these materials. Tar is produced by the distillation of coal, and pitch is the residue left after the distillation of tar. Both materials contain hydrocarbon bones of varying complexity, one of which, benzo(a)pyrene is carcinogenic. In addition heavier oils, tar and pitch have the following common characteristics: they are all skin irritants; they are solvents of lipid and cholesterol; and they are acretic and keratoplastic.

In his own experience, the author has been unable to differentiate between the effects of the two materials, but he has noted the following types of reaction: tar burn; tar erythema; allergic eczematous dermatitis; folliculitis; acne; and comedones; pitch and tar melanosis; shagreen skin; neoplastic changes; and epitheliomas. Tar erythema follows the action of bright sunlight on skin rendered sensitive by soot as yet unknown ingredient in pitch and tar. The ultraviolet of sunlight appears also related to the development of epithelioma, accelerating the action of the carcinogen in tar and pitch by some mysterious mechanism for skin malignancy has occurred much more rapidly in country workers than in city workers whose environment differs appreciably only in that they are exposed to much less sunshine. The earliest macroscopic change resulting from tar and pitch exposure is seen in the cornified layer of the skin, where keratoses occur. Somewhat later the papillomas—simple wart, typical pitch wart, and soft papillomas—appear on the face, neck, scrotum, forearms, and backs of the hands.

By way of prophylaxis against these skin changes, and especially against the development of malignant changes which may occur years after the exposure

has ceased certain suggestions are made. Work men's clothing should be relatively impermeable secured at ankles, wrist, and neck and it should be changed frequently. Protective gauntlets and goggles should be worn. Barrier creams should be applied to all susceptible parts of the body before each working shift, and a thorough bath should be taken after each shift. Frequent inspection of the skin of exposed employees is essential to prophylaxis as well as to treatment of established lesions.

This article contains 6 good color plates depicting typical skin lesions, statistical tables on the situation and latent periods of the various lesions, and a formula for starch kaolin paste used to prevent tarry thyma.

BENJAMIN F. LOUNSBURY, M.D.

**Acanthosis Nigricans and Plastic Surgery** (*Acanthosis nigricans et chirurgie plastique*) GEORGE CLOUTIER and PAUL POIRIER. *Univ. med. Canada*, 1948 77 931

Plastic surgery as an adjunct in the management of far advanced acanthosis nigricans is discussed by these authors. The case of a 22 year old female with chronic dermatitis of 6 years' duration is presented. On physical examination and subsequent biopsy the skin lesions were typical of acanthosis nigricans involving chiefly the cervical, axillary, mammary and inguinal regions and manifesting itself by exaggeration of the normal folds of the skin, numerous papillary excrescences and hyperpigmentation. The involved skin of both axillary regions was removed and replaced by skin grafts from both thighs in three operative procedures. A good cosmetic and functional result was obtained.

History revealed carcinoma in a immediate relatives. Laboratory studies disclosed an elevated basal metabolic rate on 2 occasions. The remaining portions of the history, physical and laboratory examination were not contributory.

Acanthosis nigricans is a disease of the skin characterized by an exaggeration of the normal skin folds with papillary growths and hyperpigmentation. Its frequent occurrence in cases of intra abdominal carcinoma has been noted. Although its etiology and pathogenesis are for the most part unknown, endocrine factors are believed important, as was shown by the elevated basal metabolism in this patient. The author distinguishes two types: the juvenile (benign) and the adult (those cases usually associated with intra abdominal adenocarcinoma).

C. FREDERICK KITTLE, M.D.

**Pigment Nephropathy in Battle Casualties.** HOWARD E. SWYCKE and JAMES W. CULBERTSON. *Arch. Surg.*, 1948 56 651

Deaths among soldiers of the Fifth Army who were wounded in battle during the period from January 1, 1944 to May 31, 1945 included 99 in whom pigment nephropathy was a direct or indirect cause, and another 57 in whom this syndrome was suspected of contributing to a fatal outcome. Of the 1,411 deaths on which reports were available, 68 were be-

lieved to be caused directly by pigment nephropathy whereas in another 31 it was at least a contributing cause. Autopsy was performed in 90 of these 99 cases.

Although the authors describe pigment nephropathy or lower nephron nephrosis in connection with battle casualties, they point out that it may occur in a variety of traumatic situations. In wounded soldiers the condition consists of progressive oliguria and anuria developing in patients who have undergone extensive surgery after resuscitation from shock and who appear to be recovering. Those patients most severely affected die in from 4 to 8 days after being wounded. The renal damage appears to stem from ischemia of the kidney and concomitant excretion of pigment either hemoglobin (from transfused blood intravascular hemolysis or other sources) or myoglobin (from extensive crushing of muscle). The ischemia is vasoconstrictive in nature, but it has not been determined whether the vasoconstriction results from the action of a toxin liberated from injured tissues or is a reflex phenomenon.

Analysis of the 99 deaths shows that in most instances the primary wounds were relatively severe. There were many associated wounds of varying severity. All but 3 of the patients had been in shock of some degree. Four of the 5 had sustained a transfusion reaction, crush injury or poisoning by sulfadiazine whereas the record of the fifth was so inadequate as to permit of no valid conclusions. The data on recorded blood pressures and amounts of plasma and blood administered serve as rough measures of the degree and duration of the shock. As a further indication of the severity of the wounds it is noted that in the 36 cases for which the operating time was stated, only 1 case required an operating time of less than an hour whereas 17 cases required 3 hours or more.

The authors discuss the work of investigators who have studied the syndrome in experimental animals, and the observations of clinicians. They conclude that treatment should be prophylactic. Shock should be combated and blood volume restored to normal as soon as possible. They feel that oxygen therapy should be employed more often to combat the anoxia which must result from vasoconstriction in the renal circulation. Since dehydration has been established as an etiologic factor they advocate adequate hydration of the patient as soon as possible. When used sulfadiazine must be carefully administered and the patient closely observed. Where the potentialities exist for nephropathy such drugs should be discontinued.

BENJAMIN F. LOUNSBURY, M.D.

**Necrotic Lesions of the Leg in Arteriosclerosis.** EDWARD A. EDWARDS. *N. England J. M.*, 1948 339 571

Six cases of arteriosclerotic necrosis of the skin and subcutaneous tissue of the lower extremities are presented. This condition carries the same import as necrosis of the toes or feet. It may arise spontaneous-



The therapeutic response observed, as well as the striking similarity between the calculated dose and the actual dose needed to produce therapeutic effects lends support to the validity of the original thesis upon which these studies were undertaken.

It is also significant that the observations reported here give insight into the mechanism of adaptation by malignant cells. Although the phenomenon of adaptation still constitutes a major limitation in this and other chemotherapeutic modalities, it appears that it does not involve the creation of enzymatic mechanisms *de novo* but rather the utilization of previously existent secondary pathways.

There were no deleterious effects observed particularly as regards the retina and intestinal mucosa. These tissues have been reported as having metabolic activity similar to neoplastic tissue particularly with regard to a high glycolytic activity.

DAVID H. LYNN, M.D.

**Review of the Problem of Air Contamination in Operating Rooms and of the Diverse Procedures of Air Sterilization** (Revue sur le problème de la contamination de l'air des locaux opératoires et sur les divers procédés de stérilisation de l'air) FRANK D. ALASKOZIS and MARC FLEURY. *Rev. chir.* Par. 1948, 67: 147.

Dust particles containing bacilli may travel in the air either in dry form or as minute droplets of about 0.1 micron in diameter. A number of physical factors contribute to purify the air from bacterial contamination and have been used in attempts to sterilize the air. Rise of the temperature causes evaporation and lowering of the temperature causes condensation and precipitation of these droplets. A cold object brought into a warmer room causes condensation of droplets on its surface. Therefore it is dangerous to bring a tray with sterile instruments into an unsterilized warm operating room. If the temperature of the tray is lower than that of the room, droplets containing bacteria will precipitate on its surface.

Other physical factors that have been used for purifying purposes are lowering of the air pressure, high humidity leading to precipitation, ultraviolet rays, radioactivity, electric ionization, and filtration of the air through different absorbing materials.

Also a great number of chemical substances have been used for air sterilization, especially oxidizing agents (ozone, formalin, glycol, propylene, and others). However, they are inconvenient because of their odor and irritation of the respiratory passages or they are too expensive or not effective or both.

The authors criticize the different methods in use at the present time. They have devised a method which they claim to be effective, rapid, and economical before an operation the air of the operating room is saturated with water vapor until a dense mist forms. The very small droplets of this mist fix immediately the small dust particles containing bacteria. This mist is then condensed on the surfaces of a large condenser which is cooled by water.

WERNER M. SOLMITS, M.D.

**Biologic Studies of Surgical Shock. Paroxysmal Arterial Hypertension Following Any Tissue Trauma Is Due to Adrenalin Secretion by the Suprarenal Gland** (Étude biologique du choc chirurgical. L'hypertension artérielle paroxysmique secondaire à tout traumatisme tissulaire est due à une décharge adrénalinique des surrénales) J. DRIZSEN. *Rev. chir. Par.* 1948, 67: 129.

In an earlier publication the author showed that the drop of the blood pressure in surgical shock is always preceded by a very short period of marked hypertension. By systematic continuous registration of the pressure inside of the carotid artery it could be demonstrated that this hypertensive period consists of a sequence of momentary very transitory shocks which are of too brief duration to be observed with the usual sphygmomanometer.

In the present article the author reports a series of experiments on the curarized dog to prove that the hypertension preceding the hypotension of shock is due to the secretion of adrenalin which is caused by traumatism of the tissue.

The hypertension lasts only a few seconds, the blood pressure rising about 25 to 30 seconds above the normal level. It can be repeated any number of times by a new trauma in the same animal (cutting of the skin, manipulation of the intestine, or severing of a portion of muscle). Parallel to the hypertension there occurs hyperglycemia, a further proof of the adrenergic nature of the hypertension. By the intravenous injection of adrenalin the same characteristic curve of the elevated blood pressure and hyperglycemia can be brought about.

Furthermore the volume of the spleen was measured in a plethysmograph and it was shown that the volume decreased considerably with each trauma exerted on the curarized animal.

When the lumbodrenal vein was ligated proximally and distally to the gland, subsequent traumatism failed to produce hypertension and hyperglycemia. When the splanchnic nerves were paralyzed by cocaine infiltration, subsequent trauma produced only a very slight elevation of the blood pressure.

WERNER M. SOLMITS, M.D.

## EXPERIMENTAL SURGERY

**Attempts at the Production of Experimental Neoplasms by the Injection of Thorotrast** (Versuche zur peritoneellen Untersuchung zur Frage der Geschwulstentstehung durch intravenöse Thorotrast-Injektionen) LUDWIG RULAND. *Chirurg.* 1947, 17-18: 540.

The author states that several writers have remarked that a tumor-forming process may require a latent period of from 10 to 25 years in the human before the neoplasm comes into being. In certain animals latent periods have been accurately worked out for carcinogenic agents. Thus the author decided to observe a series of animals beyond the maximum of the latent period to observe the carcinogenic properties of a 5 per cent colloidal suspension of thorium dioxide.

ly or may follow local trauma or infection. Because of the advanced age of the patients and the marked arteriosclerosis, the tissues limit infection poorly and septicemia is common. It is frequently accompanied by thrombosis of the deep veins and pulmonary embolism may occur.

Treatment usually requires hospitalization and an attempt to control infection by chemotherapy. If necrosis is widespread and deep or if infection is spreading rapidly amputation should be carried out immediately. The author favors the local use of streptokinase solution with systemic chemotherapy. If enough thrombosis prevents the femoral canal should be ligated if a present dicumol or heparin should be given. Lumbar sympathectomy should be considered if there is a good skin temperature response to spinal anesthesia and if there appears to be a chance of saving the leg. If necrosis is the cause of local infection, this should be treated by high ligation of the saphenous vein. A decision as to the need of amputation should be made as soon as possible. ROSS, M. TOYER, and M. D.

#### Fibrinolysis: Its Mechanism and Significance. R. C. MCGEE and ROYCE BROWN. *Blood* 945, 5-6.

The authors define fibrinolysis as the septic dissolution of fibrin by the direct action of a mechanism existing in normal blood. Although fibrin in normal blood usually remains intact for days or weeks, the period of time of fibrin may occur following the first of its cleavage by living organisms. Fibrinolysis is probably the result of proteolytic digestion by enzymes.

Previous experimental work has shown that proteolytic enzymes present in serum (plasmin) are effective in fibrinolysis which destroy some substrate including normal fibrin (antiplasmin). The action of plasmin proteins may also result in proteolytic action by separating enzyme and inhibitor. Recent studies have shown that streptococcal fibrinolysin causes liberation of a proteolytic enzyme (plasmin) from serum by activating its precursor (plasminogen). Thus fibrinolysis which is induced by streptokinase (chloroform, fractionation) is due to plasmin in the living subject as the active plasmin which will also digest plasma protein casing, degradation.

Antiplasmin is associated with the albumin fraction of the plasma, whereas plasmin and plasminogen are associated with the globulin fraction. Enzymes resembling plasmin have been found in various tissues especially of the lung and liver and inhibitors resembling plasmin have also been found in various tissues particularly in the spleen.

Observations in the living subject indicate that fibrinolysis may occur following stimulation of the plasma, for severe exercise or the injection of adrenalin. The mechanism of plasmin activation in these cases is obscure and can be obtained in the absence of normal function of the liver and pancreas, adrenals and suprarenal cortex. Cumulative evidence

suggests that the plasmin-antiplasmin complex plays a fundamental part in several essential physiological processes such as shock, protein breakdown, tissue equilibrium, blood coagulation, and many reactions.

S. LLOYD TETTERMAN, M.D.

#### Energy Mechanisms in Malignant Tumors in Relation to Chemotherapy. MATTHEW M. RABIN, ISRAEL S. KLEINER, and HERMAN BOLGER. *Cancer Res.* 945, 7-818.

The differences in metabolism between normal and malignant tissues have been the basis for many attempts to develop chemotherapeutic measures.

A new approach toward a rational chemotherapy of malignant tumors seems indicated in terms of energy rich phosphate bonds. Thus if malignant cells are particularly dependent on the glycolytic mechanism for their energy requirements, it might be possible to inhibit their activity if one could selectively limit the formation or utilization of these bonds.

Based on this concept, an hypothesis of block of cellular function in malignant tissue as compared to normal was formulated as follows: with the abnormal malignancy there is a significant alteration in energy mechanism of tissue. The preferred pathway involves the glycolytic mechanisms while the respiratory enzyme reactions are diminished as compared with their role in normal tissue. The respiratory functional potentiality is not absent but is residual. The glycolytic mechanism itself may be divided into (a) the primary portion (from triphosphoric acid) and (b) the tricarboxylic acid cycle which is a secondary mechanism for energy production.

To obtain maximum destruction of energy-producing reactions in malignant tissue, inhibition of the primary glycolytic mechanism would occur. Points of creation of the high energy phosphate bonds. Such reactions are inhibited by iodoacetic acid and sodium fluoride. Adaptation of malignant tissue to these inhibitors occurs and is associated with utilization of a secondary mechanism for energy production. The tricarboxylic acid cycle is a secondary pathway. Inhibition of the cycle is accomplished by the use of malonic acid which inhibits the succinate dehydrogenase system. Finally, adaptation after initial sensitivity of the malignant tissue to the glycolytic inhibitors would occur might well be accomplished over the dynamic metabolic pathways that is, those using the respiratory enzyme chains, particularly cytochrome oxidase. Such reactions might be inhibited by the use of azide which blocks oxidase activity.

This report gives the results of preliminary experiments based on the concepts mentioned. The various inhibitors were administered on divided doses to patients with the following diseases: acute myeloblastic leukemia in 10 patients, lymphatic leukemia in 4, acute monoblastic leukemia in 1, gastric carcinoma in 3, lymphosarcoma in 1, carcinoma of the colon in 3, carcinoma of the bladder in 4, carcinoma of the testis in 2, and ileocecal disease in 3.

The therapeutic response observed, as well as the striking similarity between the calculated dose and the actual dose needed to produce therapeutic effect, lends support to the validity of the original ideas upon which these studies were undertaken.

It is also significant that the observations reported here present a picture of the mechanism of adaptation by cutaneous cells. Although the phenomenon of adaptation still constitutes a major limitation in this and other dermatotherapeutic modalities, it appears that it does not involve the creation of new metabolic mechanisms *de novo*, but rather the utilization of previously existent secondary pathways.

There were no detectable effects observed, particularly in regard to the retina and intestinal mucosa. These tissues have been reported as having metabolic activity similar to neoplastic tissue, particularly with regard to high glycolytic activity.

DANA H. LEXS, M.D.

**Review of the Problem of Air Contamination in Operating Rooms and of the Diverse Procedures of Air Sterilization** (Revue sur le problème de la contamination de l'air des locaux opératoires et sur les divers procédés de stérilisation de l'air) *PAR* ALDO L. CROCIANI and MARIE FLAUREN. *Rev. chir.*, Paris, 1946, 1: 161.

The particles containing bacilli may travel in the air in dry form or as minute droplets of about one micron in diameter. A number of physical factors contribute to purify the air from bacterial contamination, and have been used in attempts to purify the air. Rise of the temperature causes evaporation and lowering of the temperature causes condensation and precipitation of these droplets. Air is not brought into a warmer room causes condensation of droplets on its surface. Therefore, air is brought in through a tray with sterile instrument. The temperature of the tray is lower than that of the room. Air is brought in through a tray with sterile instrument. The temperature of the tray is lower than that of the room.

Physical factors that have been used for purifying the air are lowering of the air pressure, raising of the air pressure, ultraviolet light, electric ionization and filtration through different absorbing materials. The use of chemical substances have been used for sterilization, especially oxidizing agents like formalin, glycol propylene and formaldehyde. They are inconvenient because of their odor and the respiratory passages are irritated or not effective or both. They have devised a method of sterilizing the air of the operating room by passing water vapor until a dense mist is formed. The very small droplets of this mist will fix the very small dust particles containing bacteria. These are then condensed on the surfaces which is cooled by water.

WERNER M. SOLMITS, M.D.

**Biologic Studies of Surgical Shock. Paroxysmal Arterial Hypertension Following Any Tissue Trauma is Due to Adrenalin Secretion by the Suprarenal Gland** (Étude biologique du choc chirurgical. L'hypertension artérielle paroxysmale secondaire à tout traumatisme tissulaire est due à un décharge adrénalinique des surrénales) *J. DERMATOL. ET CHIR.*, Paris, 1946, 67: 170.

In an earlier publication the author showed that the drop of the blood pressure in surgical shock is always preceded by a very short period of marked hypertension. By systematic continuous registration of the pressure inside of the carotid artery it could be demonstrated that this hypertensive period consists of a sequence of momentary very transitory shocks which are of too brief duration to be observed with the usual sphygmomanometer.

In the present article the author reports a series of experiments on the curarized dog to prove that the hypertension preceding the hypotension of shock is due to the secretion of adrenalin which is caused by traumatism of the tissue.

The hypertension lasts only a few seconds the blood pressure rising about 25 to 30 seconds above the normal level. It can be repeated any number of times by a new trauma in the same animal (cutting of the skin, manipulation of the intestine, or severing of a portion of muscle). Parallel to the hypertension there occurs hyperglycemia a further proof of the adrenogenic nature of the hypertension. By the intravenous injection of adrenalin the same characteristic curve of the elevated blood pressure and hyperglycemia can be brought about.

Furthermore the volume of the spleen was measured in a plethysmograph and it was shown that the volume decreased considerably with each trauma exerted on the curarized animal.

When the lumbodrenal vein was ligated proximally and distally to the gland subsequent traumatism failed to produce hypertension and hyperglycemia. When the splanchnic nerves were paralyzed by cocaine infiltration, subsequent trauma produced only a very slight elevation of the blood pressure.

WERNER M. SOLMITS, M.D.

## EXPERIMENTAL SURGERY

**Attempts at the Production of Experimental Neoplasms by the Injection of Thorotrast** (Tumeurs expérimentelles produites par l'injection de Thorotrast) *DEUTSCHE MED. WCHENSCHR.*, Leipzig, 1947, 72: 540.

The author states that several writers have remarked that a tumor forming process may require a latent period of from 10 to 25 years in the human before the neoplasm comes into being. In certain animals latent periods have been accurately worked out for carcinogenic agents. Thus the author decided to observe a series of animals beyond the maximum of the latent period to observe the carcinogenic properties of a 25 per cent colloidal suspension of thorium dioxide.



Three factors demanded consideration (1) the continued action of the thorium as an irritating foreign body in the tissues, (2) the radioactivity of the thorium and (3) the susceptibility of the animal to carcinogenesis. In these experiments both rats and guinea pigs were employed. A point of lessened resistance was produced by fracturing the tibia at the epiphysis, a point of active growth.

The animals were given an autopsy examination if death occurred from an intercurrent disease, or they were sacrificed at 26 months. Although active thorium dioxide was found in the areas of the trauma, and although an active chronic inflammatory reaction was often present no tumors were found in any of the animals. The author believes that the processes which were observed may be interpreted as precancerous manifestations.

He concludes that these experiments are equivocal, and should not be used for an interpretation of what may occur in man. The latent period for the observance of cancer in patients who have received injections of thorium has not yet been reached as this material did not become available for general use until 1934. Also the changes which he saw in his animals might be more progressive in man.

WILLIAM C. BECK, M.D.

**Amputation of the Canine Atrial Appendages.**  
H. K. HELLERSTEIN, E. SCHWARTZ, and M. DOLGIN.  
*Surgery* 94:5, 24-7-9.

The left atrial appendage is frequently the site of thrombus formation and the source of the multiple arterial emboli which often complicate rheumatic mitral disease. Since there is no effective treatment for this condition, surgical excision of the involved atrial appendage is suggested as a possible solution.

To test the feasibility of such a procedure, the left atrial appendage was surgically removed from 5 dogs; the right atrial appendage was excised in 3 dogs, and in 1 dog both appendages were removed. The procedure generally used was simple clamping at the base of the appendage, ligation, amputation, and a reinforcing transfixion suture. An anterior intercostal approach was used, with or without rib resection. Each dog received 200,000 units of penicillin daily for 2 weeks postoperatively and serial electrocardiograms were taken.

One dog died 15 minutes after the closure of the incision. The other seven dogs recovered uneventfully and were active and normal in appearance within 7 days. Follow-up electrocardiograms showed no changes indicative of myocardial damage or abnormal atrial rhythm, except that one dog had a transient intra-atrial block. Autopsies, performed 4 to 12 weeks postoperatively, revealed excellent healing of the atrial incisions in all dogs, with complete endothelialization of the endocardial surface. No mural thrombi were found. Firm adhesions were present between the visceral and parietal pericardium at the stump of the atrial appendage. There was no evidence of emboli or infarction in any other organs. The histologic report verified the gross observation of firm healing of the atrial incision.

It is concluded that one or both atrial appendages may be surgically excised in the normal dog without significantly altering the normal physiology of the heart. The feasibility of this procedure in patients with atrial appendages containing mural thrombi deserves further consideration. The atrial appendages may provide a more convenient approach in intracardiac surgery than the ventricular approach.

STANLEY W. TITELL, M.D.

# SURGERY

## GYNECOLOGY AND OBSTETRICS

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### METHODS FOR PRESERVATION AND TRANSPLANTATION OF ARTERIAL GRAFTS

#### Observations on Arterial Grafts in Dogs Report of Transplantation of Preserved Arterial Grafts in 9 Human Cases

ROBERT E. GROSS M.D., F.A.C.S. ALEXANDER H. BILL, Jr. M.D. and  
E. CONVERSE PEIRCE, 2nd M.D., Boston, Massachusetts

**I**N certain operative procedures it would be of great value to be able to bridge an arterial defect with a graft provided the method of grafting is reliable and is not cumbersome. Vein grafts (from the same individual and from other humans) have been used with some success and are reasonably satisfactory if one is repairing arteries which are not of great size. There has been no safe method for permanently replacing a segment of a very large artery especially the aorta and it is to this problem that we have turned our attention.

Veins and arteries have been grafted into animals from the same animal (autografts) from the same species (homografts) and from other species (heterografts) (1 3 4 5 6 8 9 13 14 18 26 31 32 33). It has been generally reported that autografts or homografts are more satisfactory than heterografts (5 6 8 9 14 15). Many substitutes for blood vessels have been suggested. Various inert substances have been suggested or tried for bridging blood vessel defects (10 11 23) including tubes of glass of aluminum of gold plate and

of silver lined with paraffin. All of these substances have led to thrombosis. Recently lu-cite channels for intubation of vessels (19) has led to more promising results. Rigid rings (vein lined) for the nonsuture method of joining vessels have been made from ivory (25) magnesium (28) and vitallium (1).

A wholly satisfactory solution to the problem of bridging a gap in large arteries or in the aorta would seem to lie in the direction of providing a vascular graft which is viable which would resemble the normal vessel after implantation which could withstand intra arterial pressures which would not cause thrombosis and which would not set up serious reaction in the regional tissues. Knowing that transplantation of fresh arterial grafts from one animal to another had shown varying degrees of survival in the hands of Carrel and Guthrie (6 8 14) and others (3 18 31) we undertook to repeat and extend some of their work and to investigate extensively methods for preservation and storage of arterial grafts. As a preliminary part of our investigations a study was made of the effects of transplantation of fresh aorta from one dog to another this is being reported elsewhere by Gross and Hurwitt (13).

From the Department of Surgery, (the Harvard Medical School and the Medical Services of The Children's Hospital and the Peter Bent Brigham Hospital.

Three factors demanded consideration (1) the continued action of the thorium as an irritating foreign body in the tissues, (2) the radioactivity of the thorium and (3) the susceptibility of the animal to carcinogenesis. In these experiments both rats and guinea pigs were employed. A point of lessened resistance was produced by fracturing the tibia at the epiphysis a point of active growth.

The animals were given an autopsy examination if death occurred from an intercurrent disease or they were sacrificed at 26 months. Although active thorium dioxide was found in the areas of the trauma, and although an active chronic inflammatory reaction was often present, no tumors were found in any of the animals. The author believes that the processes which were observed may be interpreted as precancerous manifestations.

He concludes that these experiments are equivocal, and should not be used for an interpretation of what may occur in man. The latent period for the observance of cancer in patients who have received injections of thorium has not yet been reached as this material did not become available for general use until 1934. Also the changes which he saw in his animals might be more progressive in man.

WILLIAM C. BECK, M.D.

Amputation of the Canine Atrial Appendages.  
H. K. HALLERSTEDT, E. SIMARCO and M. DOUGAN.  
*Surgery* 94:5, 24, 79.

The left atrial appendage is frequently the site of thrombus formation and the source of the multiple arterial emboli which often complicate rheumatic mitral disease. Since there is no effective treatment for this condition, surgical excision of the involved atrial appendage is suggested as a possible solution.

To test the feasibility of such a procedure, the left atrial appendage was surgically removed from 5 dogs; the right atrial appendage was excised in 2 dogs, and in 1 dog both appendages were removed. The procedure generally used was simple clamping at the base of the appendage, ligation, amputation, and a reinforcing transfusion suture. An anterior intercostal approach was used, with or without rib resection. Each dog received 300,000 units of penicillin daily for 3 weeks postoperatively and serial electrocardiograms were taken.

One dog died 15 minutes after the closure of the incision. The other seven dogs recovered uneventfully and were active and normal in appearance within 7 days. Follow-up electrocardiograms showed no changes indicative of myocardial damage or abnormal atrial rhythm, except that one dog had a transient intra atrial block. Autopsies, performed 4 to 12 weeks postoperatively, revealed excellent healing of the atrial incisions in all dogs, with complete endothelialization of the endocardial surface. No mural thrombi were found. Firm adhesions were present between the visceral and parietal pericardium at the stump of the atrial appendage. There was no evidence of emboli or infarction in any other organs. The histologic report verified the gross observation of firm healing of the atrial incisions.

It is concluded that one or both atrial appendages may be surgically excised in the normal dog without significantly altering the normal physiology of the heart. The feasibility of this procedure in patients with atrial appendages containing mural thrombi deserves further consideration. The atrial appendages may provide a more convenient approach in intracardiac surgery than the ventricular approach.

STANLEY W. TULL, M.D.



TABLE L. RESULTS OF IMPLANTATION OF HOMOGRAFTS (PRESERVED BY QUICK FREEZING TO -72 DEGREES C.) INTO DOG AORTAS

Recipient dog No.	Atmosphere in storage tube	Length of time used preserved	Length of life of dog post-operatively	Cause of death	Fate of graft
1-7	Air	days	do	Hemorrhage	Graft broke down
16	Air	3 (do)	do	Hemorrhage	Graft broke down and completely thrombosed
	Air	days	90 days	Hemorrhage	Graft broke down
19	Air	do	do	Hemorrhage	Graft broke down and completely thrombosed
	Air	days	4 months	Sacrificed	Intimal sclerosis
	Air	days	2 do	Hemorrhage	Graft broke down
	Air	90 days	do	Hemorrhage	Graft broke down. Two thrombi
7	Helium	do	20 do	Hemorrhage	Graft broke down. Some thrombus
1-	Helium	day	do	Peritonitis	Tubular aortal thrombus seen thick
26	Helium	do	3 do	Hemorrhage	Graft broke down and completely thrombosed
	Helium	3 day	days	Hemorrhage	Graft broke down
28-7	Helium	days	months	(Still alive)	Considerable aortal thrombus by aortotomy

Preservation of blood vessels has been studied previously by other surgeons Carrel (7-9) preserved arteries by storage in a refrigerator at temperatures above freezing in various media, including vaseline salt solution defibrinated blood and humid air. With these methods he had some degree of success in survival of the grafts following their implantation into other dogs. His results are rather difficult to evaluate because of the relatively few experiments in each method of study. Recently Blakemore and Lord (1) and also Hufnagel (20) have reported the successful preservation of arteries and veins by quick freezing and storage at temperatures well below freezing. The successful transplantation of an artery after preservation in formalin was reported by Levin and Larkin (21-22) but they were apparently unable to repeat this in later experiments. This was later successfully repeated by Guthrie (16).

The third series was designed to investigate the preservation and use of homografts (from an animal of the same species) storing the grafts at temperatures just above freezing in appropriate media the constituents of which were based on formulas developed by others interested in the field of tissue culture techniques and which were suggested to us by J. H. Hanks (17) of the Department of Bacteriology of the Harvard Medical School. We thought that it would be of interest to determine whether various methods of preservation would allow the tissues of a vessel to remain alive hence it was decided to parallel our animal experimentations with tissue culture studies of specimens of the preserved vessels (29). Microscopic studies of implanted grafts were also planned these were conducted (and will be reported) by Alan R. Moritz.

#### EXPERIMENTAL GRAFTS IN ANIMALS

branches were tied with fine silk. It was cut into 30 centimeter lengths.

When a segment of aorta was to be implanted into a recipient animal the technique used was as follows. The dog was anesthetized with intravenous nembutal and the abdomen was opened through a left rectus incision. The abdominal aorta, between the renal arteries and the inferior mesenteric artery was exposed and freed of branches for a distance of about 50 centimeters. It was then occluded in two places either by the use of aortic clamps such as described by Gross and Hufnagel (12) or by the use of tape tourniquets and severed between the two occluded points. A generous cuff was left beyond each clamp or tourniquet. After an aorta was thus divided its cut ends retracted for a distance of approximately 30 centimeters, the graft to be tested was sutured into place between those ends (Fig. 4). The anastomoses were made by a single, continuous everting mattress stitch using 5-0 Deknatel silk on an atraumatic needle. The insertion of such a graft took an average of 45 minutes following which the clamps or tourniquets were removed. The peritoneum was then brought together over the aorta and the abdomen was closed. No chemotherapy or anticoagulants were used. No damage to the spinal cord or hind limbs was observed as a result of the occlusion of the aorta during these operations.

*Series A: implantation of aortic homografts (preserved at  $-70$  degrees centigrade).* Twelve grafts were carried out with vessels which had been preserved at  $-70$  degrees centigrade. The segments of aorta were obtained from donor dogs and placed in sterile test tubes which were hermetically sealed. Seven of these contained room air. In the five remaining tubes the air in the tube was replaced by an atmosphere of helium under pressure of 20 to 40 millimeters of mercury above atmospheric level. This was done in an attempt to repeat the work of Hufnagel (20) who felt that helium (particularly under pressure) was a better conductor of heat than was air and hence would allow quicker freezing of the vessel.

When sealed the test tube containing an aortic segment was immersed in a beaker con-

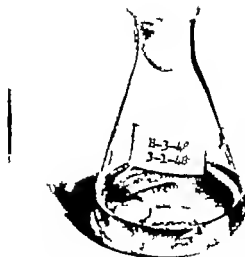


Fig. 1. Blood vessel in Erlenmeyer flask containing nutrient medium, ready for storage in refrigerator.

taining 300 cubic centimeters of 95 per cent alcohol in which was floating one-half its volume of carbon-dioxide ice. The temperature of this mixture was  $-72$  degrees centigrade. The tubes were kept in this for 15 minutes and were then stored in a carbon-dioxide ice refrigerator at a temperature of about  $-70$  degrees centigrade. The vessels were stored in this manner for lengths of time varying between 2 and 35 days. When a vessel was to be implanted into a recipient dog it was thawed by immersing its test tube for 10 minutes in a bath of water at 35 degrees centigrade after which it was removed from the tube and placed in a bowl of Ringer's solution at the operating table. It was then sutured into the abdominal aorta of a recipient dog as described previously. Table I shows the results.

It will be seen that of 12 dogs 1 dog died of pneumonia in 19 days. 2 dogs survived for at least 6 months with fairly good arterial pathways and 9 died of breakdown of one of the anastomoses. The grafts which broke down did so between 2 and 12 days in 7 cases and at 20 and 30 days in the other 2. Examination of these 9 autopsy specimens showed that the grafts themselves were friable and necrotic to the point of allowing the sutures to pull out

TABLE I—RESULTS OF IMPLANTATION OF HOMOGRAFTS (PRESERVED BY QUICK FREEZING TO -2 DEGREES C.) INTO DOG AORTAS

Recipient dog No.	Atmosphere in storage tube	Length of time vessel preserved	Length of life of dog post-operatively	Cause of death	Fate of graft
	Air	48 hr	5 days	Hemorrhage	Graft broke down
26	Air	48 hr	48 hr	Hemorrhage	Graft broke down and completely thrombosed
	Air	48 hr	30 days	Hemorrhage	Graft broke down
30	Air	48 hr	7 days	Hemorrhage	Graft broke down and completely thrombosed
32	Air	48 hr	6 months	Ischemic	Ischemic necrosis
34	Air	48 hr	6 hr	Hemorrhage	Graft broke down
35	Air	48 hr	48 hr	Hemorrhage	Graft broke down. Two thrombi
	Formalin	48 hr	30 days	Hemorrhage	Graft broke down. Some thrombi
	Formalin	48 hr	48 hr	Pneumonia	Tubercular mural thrombus seen distal
40	Formalin	48 hr	8 days	Hemorrhage	Graft broke down and completely thrombosed
41	Formalin	48 hr	48 hr	Hemorrhage	Graft broke down
42	Formalin	48 hr	3 months	Still alive	Considerable mural thrombus by aorta

Preservation of blood vessels has been studied previously by other surgeons. Carrel (7-9) preserved arteries by storage in a refrigerator at temperatures above freezing in various media including vaseline salt solution defibrinated blood and humulair. With these methods he had some degree of success in survival of the grafts following their implantation into other dogs. His results are rather difficult to evaluate because of the relatively few experiments in each method of study. Recently Blakemore and Lord (11) and also Hufnagel (20) have reported the successful preservation of arteries and veins by quick freezing and storage at temperatures well below freezing. The successful transplantation of an artery after preservation in formalin was reported by Levin and Larkin (21-22) but they were apparently unable to repeat this in later experiments. This was later successfully repeated by Guthrie (16).

Based on knowledge of the above previously published data, we outlined and completed three sets of animal experiments. In the first series of experiments an attempt was made to duplicate the work of Blakemore and Lord and of Hufnagel in quick freezing the grafts and storing them at about -70 degrees centigrade. The second series was to investigate further the feasibility of preservation and use of heterografts (from one species to another).

The third series was designed to investigate the preservation and use of homografts (from an animal of the same species) storing the grafts at temperatures just above freezing in appropriate media, the constituents of which were based on formulas developed by others interested in the field of tissue culture techniques and which were suggested to us by J. H. Hanks (17) of the Department of Bacteriology of the Harvard Medical School. We thought that it would be of interest to determine whether various methods of preservation would allow the tissues of a vessel to remain alive; hence, it was decided to parallel our animal experiments with tissue culture studies of specimens of the preserved vessels (29). Microscopic studies of implanted grafts were also planned; these were conducted (and will be reported) by Alan R. Moritz.

#### EXPERIMENTAL GRAFTS IN ANIMALS

Grafting into the abdominal aortas of dogs was selected as the method for the operative work. In such a large vessel anastomoses are easily performed and it is possible to evaluate the grafts without being hampered by thromboses which are apt to be troublesome when working with small vessels. The arteries to be preserved and tested were taken under sterile conditions from animals which had been sacrificed. The aorta was removed and its

branches were tied with fine silk. It was cut into 3.0 centimeter lengths.

When a segment of aorta was to be implanted into a recipient animal the technique used was as follows. The dog was anesthetized with intravenous nembutal and the abdomen was opened through a left rectus incision. The abdominal aorta between the renal arteries and the inferior mesenteric artery was exposed and freed of branches for a distance of about 5.0 centimeters. It was then occluded in two places either by the use of aortic clamps such as described by Hufnagel (12) or by the use of rubber tourniquets and severed between the clamped point. A generous cuff was left on each side of the divided aorta. The proximal end of the aorta was clamped or tied with a suture. The distal end of the aorta was retracted proximally 3.0 centimeters and the graft to be inserted was sutured into the aorta between those points. The anastomosis was made by a continuous suture stitch using 5-0 Deknatel silk thread and a fine needle. The insertion of the graft took an average of 45 minutes in which the clamps or tourniquets were removed. The peritoneum was then sutured together over the aorta and the abdominal wall was closed. No chemotherapy or antibiotics were used. No damage to the spinal cord or hind limbs was observed as a result of the occlusion of the aorta during these operations.

*Series A: Implantation of aortic homografts (preserved at  $-70$  degrees centigrade).* Twelve grafts were carried out with vessels which had been preserved at  $-80$  degrees centigrade. The segments of aorta were obtained from donor dogs and placed in sterile test tubes which were hermetically sealed. Seven of these contained room air. In the five remaining tubes the air in the tube was replaced by an atmosphere of helium under pressure of 20 to 40 millimeters of mercury above atmospheric level. This was done in an attempt to repeat the work of Hufnagel (10) who felt that helium (particularly under pressure) was a better conductor of heat than was air and hence would allow quicker freezing of the vessel.

When sealed the test tube containing an aortic segment was immersed in a beaker con-



Fig. 1. Erlenmeyer flask containing carbon dioxide ice for use as refrigerator.

taining 500 cubic centimeters of 95 per cent alcohol in which was floating one-half its volume of carbon-dioxide ice. The temperature of this mixture was  $-70$  degrees centigrade. The tubes were kept in this for 15 minutes and were then stored in a carbon-dioxide ice refrigerator at a temperature of about  $-70$  degrees centigrade. The vessels were stored in this manner for lengths of time varying between 1 and 30 days. When a vessel was to be implanted into a recipient dog it was thawed by immersing its test tube for 10 minutes in a bath of water at  $+5$  degrees centigrade, after which it was removed from the tube and placed in a bowl of Ringer's solution at the operating table. It was then sutured into the abdominal aorta of a recipient dog as described previously. Table I shows the results.

It will be seen that of 12 dogs 1 dog died of pneumonia in 10 days, 2 dogs survived for at least 6 months with fairly good arterial pathways and 0 died of breakdown of one of the anastomoses. The grafts which broke down did so between 1 and 12 days in 5 cases and at 20 and 30 days in the other 2. Examination of these 6 autopsy specimens showed that the grafts themselves were viable and necrotic to the point of allowing the sutures to pull out





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*Series A implantation of aortic homografts (preserved at  $-70$  degrees centigrade)* Twelve grafts were carried out with vessels which had been preserved at  $-70$  degrees centigrade. The segments of aorta were obtained from donor dogs and placed in sterile test tubes which were hermetically sealed. Seven of these contained room air. In the five remaining tubes, the air in the tube was replaced by an atmosphere of helium under pressure of 20 to 40 millimeters of mercury above atmospheric level. This was done in an attempt to repeat the work of Hufnagel (20) who felt that helium (particularly under pressure) was a better conductor of heat than was air and hence would allow quicker freezing of the vessel.

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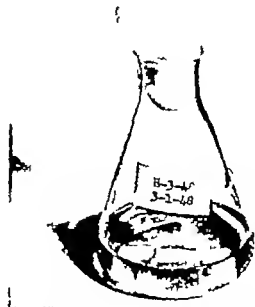


Fig. 1. Blood vessel in Erlenmeyer flask containing nutrient medium, ready for storage in refrigerator.

taining 300 cubic centimeters of 95 per cent alcohol in which was floating one half its volume of carbon-dioxide ice. The temperature of this mixture was  $-72$  degrees centigrade. The tubes were kept in this for 15 minutes and were then stored in a carbon-dioxide ice refrigerator at a temperature of about  $-70$  degrees centigrade. The vessels were stored in this manner for lengths of time varying between 2 and 35 days. When a vessel was to be implanted into a recipient dog it was thawed by immersing its test tube for 10 minutes in a bath of water at 35 degrees centigrade after which it was removed from the tube and placed in a bowl of Ringer's solution at the operating table. It was then sutured into the abdominal aorta of a recipient dog as described previously. Table I shows the results.

It will be seen that of 12 dogs 1 dog died of pneumonia in 19 days 2 dogs survived for at least 6 months with fairly good arterial pathways and 9 died of breakdown of one of the anastomoses. The grafts which broke down did so between 2 and 12 days in 7 cases, and at 20 and 30 days in the other 2. Examination of these 9 autopsy specimens showed that the grafts themselves were friable and necrotic to the point of allowing the sutures to pull out

TABLE II.—RESULTS OF IMPLANTATION OF HETEROGRAFTS (PRESERVED IN 10 PER CENT DOG SERUM IN BALANCED SALT SOLUTION AT 1 TO 4 DEGREES C.) INTO DOG AORTAS

Species of graft	Source of graft	Length of time vessel preserved	Length of life of dog post-operatively	Cause of death	Fate of graft
I	Hog	hours	3 months	(Still alive)	Aneurysmal dilatation of graft by aneurysm
II	dog	days	30 days	Sacrificed	Completely thrombosed
III	dog	days	6 months	Sacrificed	Excellent
IV	dog	days	30 days	Peritonitis	Excellent
V	Bab.	days	3 months	Sacrificed	Marked intimal sclerosis
VI	Bab.	days	days	Hemorrhage	Degenerated
VII	Human	days	months	(Still alive)	Completely thrombosed as shown by aneurysm
VIII	Human	days	months	(Still alive)	Great dilatation of graft as shown by aneurysm

before filtration had taken place. In our hands this method of preservation by freezing gave highly unsatisfactory results.

**Series B** *implantation of aortic heterografts (preserved in balanced salt solution and 10 per cent dog serum at 1 to 4 degrees centigrade)* A small number of heterografts were transplanted into dogs to study the effects of transfer of arteries from one species to another. Four vessels from a hog, from a baboon, and 1 vessel from a human were grafted into abdominal aortas of dogs. These vessels were obtained within 2 to 3 hours of death and were stored at from 1 to 4 degrees centigrade in a balanced salt solution to which 10 per cent dog serum was added. (The method of preservation is fully described in Series C.) The vessels were stored for varying periods of time before being implanted into recipient animals as recorded in Table II.

Examination of Table II shows that the use of baboon aorta was uniformly unsatisfactory, while 3 of the hog vessels and the one piece of human vessel were partially successful in carrying blood for protected periods of time. This small series of experiments in transplanting vessels from one species to another would seem to indicate that success or failure will depend upon the immunological reaction between the two species involved in the transfer. In some combinations, heterografts seem to live, whereas other combinations of heterografts cause an intense reaction which leads to rapid degeneration or thrombosis of the implanted vessels.

**Series C** *implantation of aortic homografts (preserved in balanced salt solution and 10 per*

*cent dog serum at 1 to 4 degrees centigrade).* Twenty-five experiments were carried out with segments of aorta which had been stored in a medium which would supply minerals and nutrient elements to keep the tissue of the vessel alive. Each segment was obtained in a sterile manner and was then placed in a sterile 25 or 50 cubic centimeter Erlenmeyer flask which contained enough of the nutrient medium to just cover the graft. The medium was composed of 10 per cent homologous (dog) serum in balanced salt solution<sup>1</sup> which was maintained at a fairly constant pH by means of a buffer. To this medium was added enough of the salts of penicillin and streptomycin to give a concentration of 50 units of each drug per cubic centimeter of fluid. The flask was closed with a sterile cotton stopper and placed in an electric refrigerator of the hospital's blood bank, which is maintained with great care between the temperatures of 1 and 4 degrees centigrade. (A cotton stopper was used originally to allow free diffusion of carbon dioxide and oxygen, but subsequent studies show that a rubber cap is equally satisfactory and is probably more efficient in maintaining a suitable pH range in the flask contents.) After

<sup>1</sup>The balanced salt solution is a modification of T. rode solution prepared and supplied to us by J. H. Hanks. It is made as follows:

Stock solution, content per 50 cc. NaCl 20 gm., KCl 5 gm.,  $MgSO_4$  7.16 gm.,  $MgCl_2$  6.44 gm.,  $CaCl_2$  45 gm. (dissolved separately),  $NaH_2PO_4$  5 gm., 10.38 gm. of  $Na_2HPO_4$  16.0 gm.,  $K_2HPO_4$  5 gm., glucose 5 gm., 4 per cent phenol red 5 cc.

Buffer: 4 per cent  $NH_4CO_3$ .

The stock solution is stored in room temperature with chloroform.

The final solution is made by diluting the stock solution 1:10, and adding buffer (previously autoclaved) per 50 cc. This is stored in cotton-stoppered containers in the ice box. It has an equilibrium at about pH 7.0.

preservation in this manner and before grafting a segment of vessel has physical qualities very similar to those of a fresh vessel. This is in contrast to the frozen vessels of Series A which were often quite friable when thawed out.

We do not mean to imply that the temperature range of 1 to 4 degrees centigrade is necessarily the most optimum one for storage of blood vessels. Indeed we have not extensively studied the preservation of tissue at many ranges of temperature above freezing because there seems to be little practical value in pursuing such investigations. We believed it to be worth while to study methods of preservation only at the low temperatures of refrigeration which are available to us and to many surgeons such as that commonly used in blood bank storage systems where the range is usually 1 to 4 degrees centigrade.

As we have used it this method has proved extremely satisfactory. It will be seen that among the 25 dogs with implanted grafts we had no deaths from disruption of the graft. There were 3 instances of complete thrombosis. In 1 of these a vessel which had been preserved for 1 day the graft was larger in diameter than the recipient aorta when implanted giving an effect like that of a slight aneurysm. In the 2 others the grafts had been preserved for 56 days and 98 days respectively which is considerably longer than we can now recommend for reliable preservation of grafts. In the remaining 22 dogs the grafts were known to be carrying blood at intervals from 4 days to 10 months after operation (Table III).

When viewed grossly at postmortem examination the vessels were quite satisfactory save for the 3 which were wholly thrombosed. There was very little reaction in the retroperitoneal tissues around the grafts. Inspection of the intima of the grafts in the sacrificed animals has shown 4 which had small insignificant mural thrombi. One animal which died of hepatitis 20 days after implantation of a 34 day preserved graft showed a thickened irregular suture line. One graft sacrificed 3 months after implantation of a 5 day preserved specimen showed considerable intimal sclerosis. All of the remaining grafts which have



Fig. 3. Photomicrograph of tissue culture of piece of dog aorta after 28 days of storage in 10 per cent homologous serum in balanced salt solution. The black mass in the lower third of the picture is the border of the original piece of aorta. The islet substances in the upper two-thirds of the photograph are viable and growing cells, indicating that the specimen of aorta is alive after the 28 days of storage.

been examined after sacrifice have been in excellent condition by gross examination (Fig. 6). A few of the grafts seemed to be thinned somewhat. In several specimens the grafted portion of aorta was much less elastic than were the neighboring portions of host aorta.

Eight of the 25 dogs have not yet been sacrificed. Their grafts will be examined after

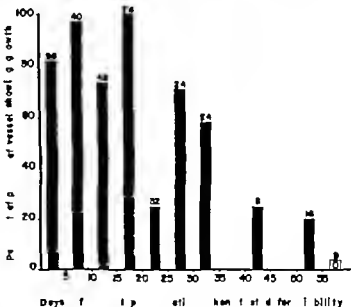


Fig. 3. Results of tissue culture studies to test viability of pieces of dog blood vessels which had been stored in 10 per cent homologous serum in balanced salt solution at 1 to 4 degrees C. The number above each column indicates the number of tissue culture tests which were made. Most of the vessels appeared to be viable for 35 to 40 days.

TABLE II—RESULTS OF IMPLANTATION OF HETEROGRAFTS (PRESERVED IN 10 PER CENT DOG SERUM IN BALANCED SALT SOLUTION AT 1 TO 4 DEGREES C.) INTO DOG AORTAS

Recipient dog No.	Source of graft	Length of time graft preserved	Length of life of dog post-operatively	Cause of death	Fate of graft
41	Hog	hours	5 months	(Still alive)	Aneurysmal dilatation of graft by aneurysm
201	Hog	da	20 da	Sacrificed	Completely thrombosed
202	Hog	da	5 months	Sacrificed	Excellent
	Hog	da	30 da	Pneumonia	Excellent
	Baboon	da	months	Sacrificed	Marked intimal sclerosis
30	Baboon	da	da	Hemorrhage	Dilatated
	Baboon	da	months	(Still alive)	Completely thrombosed as shown by aneurysm
29-32	Human	da	months	(Still alive)	Great dilatation of graft as shown by aneurysm

before fibrous union had taken place. In our hands this method of preservation gave highly unsatisfactory results.

**Series B** implantation of aortic heterografts (preserved in balanced salt solution and 10 per cent dog serum at 1 to 4 degrees centigrade). A small number of heterografts were transplanted into dogs to study the effect of transfer of arteries from one species to another. Four vessels from a hog were implanted in a baboon and 1 vessel from a human were grafted into abdominal aorta of dog. These vessels were obtained within 2 to 3 hours of death and were stored at from 1 to 4 degrees centigrade in a balanced salt solution to which 10 per cent dog serum was added. (The method of preservation is fully described in Series C.) The vessels were stored for varying periods of time before being implanted into recipient animals, as recorded in Table II.

Examination of Table II shows that the use of baboon aorta was uniformly unsatisfactory while 3 of the hog vessels and the one piece of human vessel were partially successful in carrying blood for protracted periods of time. This small series of experiments in transplanting vessels from one species to another would seem to indicate that success or failure will depend upon the immunological reaction between the two species involved in the transfer. In some combinations, heterografts seem to live whereas other combinations of heterografts cause an intense reaction which leads to rapid degeneration or thrombosis of the implanted vessels.

**Series C** implantation of aortic homografts (preserved in balanced salt solution and 10 per

cent dog serum at 1 to 4 degrees centigrade). Twenty five experiments were carried out with segments of aorta which had been stored in a medium which would supply minerals and nutrient elements to keep the tissue of the vessel alive. Each segment was obtained in a sterile manner and was then placed in a sterile 25 or 50 cubic centimeter Ehrlemeyer flask which contained enough of the nutrient medium to just cover the graft. The medium was composed of 10 per cent homologous (dog) serum in balanced salt solution<sup>1</sup> which was maintained at a fairly constant pH by means of a buffer. To this medium was added enough of the salts of penicillin and streptomycin to give a concentration of 50 units of each drug per cubic centimeter of fluid. The flask was closed with a sterile cotton stopper and placed in an electric refrigerator of the hospital blood bank which is maintained with great care between the temperatures of 1 and 4 degrees centigrade. (A cotton stopper was used originally to allow free diffusion of carbon dioxide and oxygen but subsequent studies show that a rubber cap is equally satisfactory and is probably more efficient in maintaining suitable pH range in the flask contents.) All

<sup>1</sup>The balanced salt solution is a modification of Tyndall's as now prepared and supplied to us by J. H. Hawks. It is made as follows:

Stock solution contains per 50 c. c. NaCl 30 gm., KCl 5 gm.,  $\text{Na}_2\text{SO}_4$  11 gm.,  $\text{CaCl}_2$  6 gm.,  $\text{MgSO}_4$  1 gm. (dissolved separately),  $\text{NaH}_2\text{PO}_4$  1 gm. (to 10 gm. of NaCl),  $\text{K}_2\text{HPO}_4$  0.5 gm., glucose 5 gm., 4 per cent phenol red 1 c. c.

Buffer: 4 per cent  $\text{NaHCO}_3$ .

The stock solution is stored at room temperature in the chloroform.

The final solution is made by diluting the stock solution 10 c. c. and adding 5 c. c. of buffer (previously autoclaved) to 50 c. c. This is stored in cotton-stoppered containers in the box. It has an equilibrium pH of 7.4.

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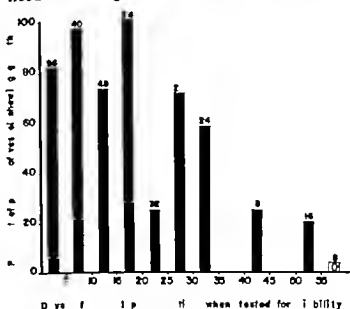


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In the first part of this work 8 pieces of tissue were cultured from each of 12 dog aortas the pieces of vessel being obtained within 2 to 5 hours after death of the animals. Of the 96 pieces of vessels which were so planted 91 grew out fibroblastic cells.

Study of portions of dog aorta which had been stored at  $-70$  degrees centigrade (Series A) showed that planting of 34 such specimens led to growth in only 2 instances. The freezing and thawing process doubtless had killed the tissue cells in most instances.

Studies of baboon aortas hog aortas and human aortas each of which had been stored in the cold in balanced salt solution containing 10 per cent dog serum (Series B) showed that most of the vessels were living after more than a month.

Detailed studies were made of dog aortas each of which had been stored at 1 to 4 degrees centigrade in balanced salt solution containing 10 per cent dog serum (Series C). Samples of the vessels were planted at varying times after initial storage of them to determine how long the vessels were in a viable state. Figure 3 summarizes the data which were obtained. It will be seen that most of the vessels were living and could be grown out on tissue culture for as long as a month or more. After 30 or 35 days there was a marked diminution in the number of aortas which were still living. After 55 days all vessels were found to be dead. These studies lead us to believe that arteries can be stored and kept viable for a little more than a month by the technique which is described in detail under Series C.

#### DISCUSSION

We believe that there are three main factors which might influence the success or failure of an arterial graft: (1) the viability of the vessel at the time of implantation, (2) the degree of the immunological reaction between the host and the graft, and (3) the technique employed in making the anastomoses.

In our work with dogs we have had good results with the transplantation of arterial homografts which had been stored at low temperature in 10 per cent homologous serum in balanced salt solution. We have set certain time limits for obtaining the blood vessel seg-

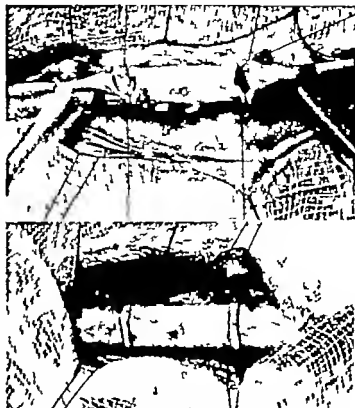


Fig. 4. Preserved aortic graft being implanted into abdominal aorta of a dog. a, above, Graft in place. b, Completion of anastomosis (everted, continuous, mattress suture employed).

ments after death of the donor: a period of 3 or 4 hours is satisfactory but it probably should not exceed 6 hours. Vessels removed as long as 6 hours after death were found to be still viable by tissue culture studies, and successful transplants could be carried out with them. Beyond 6 hours we felt that there was a likelihood of rapid appearance of postmortem change and of bacterial contamination.

From animal experimentation we found that vessels could be stored (at low temperature and in 10 per cent homologous serum in balanced salt solution) and subsequently used for grafting into other animals of the same species. The upper limits of safety for storing vessels under these conditions is probably in the region of 35 or 40 days. We have selected this limit because aortic grafts in dogs were successful up until this time, and thereafter began to fail. Furthermore tissue culture studies also indicated that viability of vascular segments is maintained for approximately 35 or 40 days and then rapidly declines.

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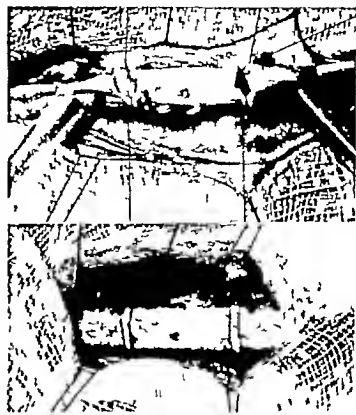


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TABLE III. RESULTS OF IMPLANTATION OF HOMOGRAFTS (PRESERVED IN 10 PER CENT DOC FRUIT IN BALANCED SALT SOLUTION AT 1 TO 4 DEGREES C.) INTO DOG AORTAS

Re- sult	Length of time (days) prior to grafting	Length of life of dog after operation	Cause of death	Fate of graft
—	da	da	Sacrificed	Thrombosed (Graft larger than host aorta when implanted)
—	da	10 hr	Sacrificed	Good Small mural thrombus
—	da	da	Sacrificed	Good Small mural thrombus
10	da	10 hr	Taken	Excellent by aortogram
—	da	10 hr	Sacrificed	Good Tubular mural thrombus
—	da	10 hr	Sacrificed	Excellent
—	da	10 hr	Sacrificed	Good Considerable mural sclerosis
14	—	10 hr	Sacrificed	Good Slight dilatation
—	10	—	Sacrificed	Excellent
—	—	—	Sacrificed	Excellent
—	—	—	Sacrificed	Excellent
—	—	—	Sacrificed	Excellent by aortogram ? Small mural thrombus
—	—	—	Sacrificed	Excellent by aortogram
—	—	—	Sacrificed	Excellent
—	—	—	Sacrificed	Excellent by aortogram Tiny mural thrombus
10	—	—	Sacrificed	Excellent
—	—	—	Sacrificed	Excellent
—	10	—	Sacrificed	Excellent by aortogram ? Tiny mural thrombus at the anastomosis
—	10	—	Sacrificed	Excellent Small mural thrombus Graft poor color
—	—	10 hr	Sacrificed	Excellent by aortogram
—	—	10 hr	Sacrificed	Excellent by aortogram
—	10	10 hr	Sacrificed	Completely thrombosed
—	10	10 hr	Sacrificed	Excellent by aortogram
—	10	10 hr	Sacrificed	Excellent
—	10	10 hr	Sacrificed	Completely thrombosed

longer periods of time. In each of these 8 animals the graft has been studied during life by means of aortography employing roentgen visualization of the abdominal aorta (Fig. 5). In all of these 8 dogs the aortic graft is patent and has the same caliber as the adjacent host aorta. In 3 of them there are one or several tiny irregularities at anastomotic lines which probably are insignificant mural thrombi and which do not diminish the caliber of vessel lumina to any important degree.

Inspection of Table III will show that storage of the grafts for more than 50 days appears to be unsatisfactory. Of the 4 vessels kept for more than 50 days before grafting 1 was not available for study because the animal died on the fourth day from intestinal obstruction. Two vessels were thrombosed and only 1

was wholly satisfactory. Of the 21 grafts stored less than 50 days before implantation, 20 were satisfactory and only 1 was unsatisfactory. It is noteworthy that in this whole series not one animal died from breakdown of a graft.

#### TISSUE CULTURE EVALUATION OF METHODS OF ARTERIAL PRESERVATION

The vessels which were used in all three experimental series were examined by making tissue cultures of them at appropriate intervals to determine their viability (Fig. 2). These tissue cultures were made under the guidance of J. H. Hanks and John Enders. The work will be described in greater detail elsewhere (29) but the principal results are summarized herewith.

In the first part of this work 8 pieces of tissue were cultured from each of 12 dog aortas the pieces of vessel being obtained within 2 to 5 hours after death of the animals. Of the 96 pieces of vessels which were so planted 91 grew out fibroblastic cells.

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From animal experimentation we found that vessels could be stored (at low temperature and in 10 per cent homologous serum in balanced salt solution) and subsequently used for grafting into other animals of the same species. The upper limits of safety for storing vessels under these conditions is probably in the region of 35 or 40 days. We have selected this limit because aortic grafts in dogs were successful up until this time, and thereafter began to fail. Furthermore tissue culture studies also indicated that viability of vascular segments is maintained for approximately 35 or 40 days and then rapidly declines.

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Dog	Age	Length of time vessel preserved	Length of life of dog after operation	Cause of death	Fate of graft
1	1	da	da	sacrificed	Thrombosed (Graft larger than host aorta, less implanted)
2	1	da	months	sacrificed	Good Small mural thrombus
3	1	da	da	sacrificed	Good Small mural thrombus
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15	1	da	months	sacrificed	Excellent by aortogram ? Tiny mural thrombus
16	1	da	months	sacrificed	Excellent
17	1	da	months	sacrificed	Excellent
18	1	da	months	sacrificed	Excellent by aortogram ? Tiny mural thrombus at the anastomosis
19	1	da	months	sacrificed	Fair Small mural thrombi Graft poor color
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21	1	da	months	sacrificed	Excellent by aortogram
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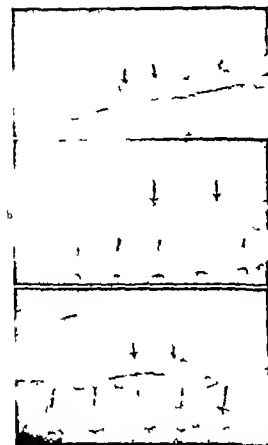


Fig. 5. Aortograms of homografts in abdominal aortas of dogs, made during life by diodrast injection through catheter which had been threaded up from the femoral artery. All of the grafts had been previously stored in 10 per cent dog serum in balanced salt solution at  $-70^{\circ}$  to  $-4^{\circ}$  degrees C. The graft is the segment between the two arrows. *a*, Dog 70-47. Graft stored for 30 days. Aortogram made 6 months after insertion of graft. *b*, Dog 44-48. Graft stored for 43 days. Aortogram made 6 months after insertion of graft. *c*, Dog 67-48. Graft stored for 70 days. Aortogram made 1 month after insertion of graft.

ported by Gross and Hurwitt (12) we have now observed in this laboratory the results of four categories of aortic grafts. They are (1) fresh homografts (2) homografts from tissue preserved by quick freezing to about  $-70^{\circ}$  degrees centigrade (3) heterografts (hog to dog, baboon to dog, and human to dog) from tissue preserved in 10 per cent dog serum in balanced salt solution and (4) homografts from tissue preserved in 10 per cent dog serum in balanced salt solution. In our hands, the three series in which the grafts could be shown to be viable up to the time of implantation

were much more successful than the series of homografts preserved by quick freezing in which life could seldom be demonstrated by tissue culture. It is important to note that the homoplastic tissue preserved in a living state (up to 43 days) in the balanced salt and 10 per cent serum mixture was as satisfactory as fresh tissue for grafting. From our various observations we believe that a graft is more apt to be successful if it is viable when implanted.

The factor of immunological reaction between graft and host is exceedingly difficult to evaluate. Our series of heterografts is small and no conclusions can be drawn therefrom. However it was a distinct surprise to find that any of the grafts from one species to another would survive. Indeed the microscopic structure of the grafts which were transferred from hog to dog showed better preservation of the media than was the case in any of the dog to dog homografts. The grafts from baboon to dog on the other hand were very poor both grossly and microscopically. This raises the interesting possibility that the transplantation of heterografts between certain species may be practical. If it could be proved for example, that vessels of sheep, dog or hog could be used successfully in human beings, we could have available a relatively convenient source of blood vessel grafts. The successful transplantation of fresh dog arteries to the femoral artery in 3 human beings is being reported by Oudet (26) from Paris. He stated in a personal communication (27) that dog vessels were used rather than human arteries because French law prohibits autopsy (and any chance of procuring vessels from a dead body) until 24 hours postmortem. He was able to demonstrate by arteriography that the dog vessel grafts were patent but he did not state how long after operation these roentgenographic studies were made.

While our laboratory experiences convinced us of the dependability of homografts—as far as dog to dog is concerned—there is, of course

We have had some measure of success with small series of 3 grafts, both are definitely known to be nonviable. These grafts were stored in 4 per cent neutral formalin for from 10 to 15 days, were then rinsed thoroughly in buffered salt solution, and implanted into recipient animals. All grafts carried blood 25 for several months, but roentgenograms of some of these show calcification in the graft walls.

considerable doubt regarding the possibility of safely transferring arteries from one human to another. While it is true that there might be no correlation between what occurred in dogs and what might happen to homografts in humans, our laboratory experiences did give us some courage to attempt grafts in patients for bridging gaps in large arteries or in the aorta when the circumstances at the operating table demanded such therapy.

#### ARTERIAL GRAFTS IN HUMAN CASES

Segments of large arteries or aorta have been accumulated from human subjects who have died in automobile accidents and from whom we were able to get the material by the courtesy and co-operation of the medical examiner. In all instances the vessels were removed within a few hours after death of the individual and in no instance was the time lapse greater than 5 hours. The body was always opened under aseptic conditions (operator with cap, mask, sterile gown and gloves; skin preparation with tincture of iodine; sterile drapes, instruments, etc.). The acquired segments of vessel—iliac, carotid, subclavian and aortic—were preserved in individual flasks and just covered with the balanced salt solution described previously under Series C except that the 10 per cent serum was human in origin. These flasks were then stored in a carefully regulated refrigerator (of the hospital's blood bank) at 1 to 4 degrees centigrade.

Eight of these human grafts have been implanted into patients who had a cyanotic type of congenital heart disease and in whom it was desirable to make some sort of a shunt of blood (the Blalock-Taussig principle) from the aorta or one of its branches into the pulmonary artery. Ordinarily it is possible to bring such vessels together for a direct anastomosis by the Blalock (2) or the Potts (30) techniques but under some circumstances it is very difficult to establish such shunts without excessive tension on the suture lines. While we hasten to express the opinion that direct anastomoses will in the majority of cases prove to be superior to any method which employs an interposed vessel, it is also probably true that the use of a graft in an occasional case (which will

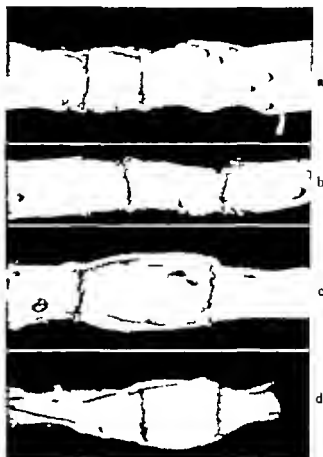


Fig. 6. Photographs of homografts in abdominal aortas of dogs. Prior to their implantation all grafts had been preserved in 10 per cent dog serum in balanced salt solution at 1 to 4 degrees C. a, Dog 150-47. Graft stored 4 days; animal sacrificed 3 months after implantation. b, Dog 187-47. Graft stored 14 days; animal sacrificed 12 days after implantation. c, Dog 183-47. Graft stored 7 days; animal sacrificed 6 months after implantation. d, Dog 170-47. Graft stored 20 days; animal sacrificed 6 months after implantation.

allow arterial junctions to be made without the slightest tension) will give a result which is better than that which would have been obtained from a poor direct anastomosis. These same general principles also will probably hold true for treatment of coarctation of the aorta. Excision of a constricted segment and anastomosis of the remaining ends of aorta give a very satisfactory result in most cases but in some instances a very long portion of aorta must be excised or else the remaining aortic ends are inelastic and cannot be easily apposed. Under either set of circumstances the use of an interposed graft may prove to be the most satisfactory method of re-establishing an aortic pathway of normal size. The validity of this statement is suggested by the pleasing result obtained in Case 9 wherein a graft was



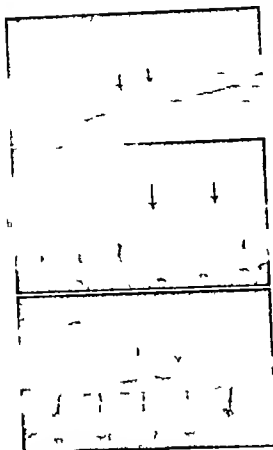


Fig. 5. Aorticograms of homografts. (1) Abdominal aorta of dog, made during life. (2) Contrast injection through catheter, which has been threaded up from the femoral artery. All of the grafts had been previously stored in per cent dog serum in balanced salt solution at  $+4$  degrees C. The graft is the segment between the 1 arrows. In each instance the graft is patent. Dog 70 47. Graft stored for 30 days. Aorticogram made 6 months after insertion of graft. Dog 44 48. Graft stored for 4 days. Aorticogram made 6 months after insertion of graft. Dog 67 48. Graft stored for 70 days. Aorticogram made 6 months after insertion of graft.

ported by Gross and Hurwitt (12) we have now observed in this laboratory the results of four categories of aortic grafts. They are (1) fresh homografts, (2) homografts from tissue preserved by quick freezing to about  $-70$  degrees centigrade, (3) heterografts (hog to dog, baboon to dog, and human to dog) from tissue preserved in 10 per cent dog serum in balanced salt solution and (4) homografts from tissue preserved in 10 per cent dog serum in balanced salt solution. In our hands, the three series in which the grafts could be shown to be viable up to the time of implantation

were much more successful than the series of homografts preserved by quick freezing in which life could seldom be demonstrated by tissue culture. It is important to note that the homoplastic tissue preserved in a living state (up to 42 days) in the balanced salt and 10 per cent serum mixture was as satisfactory as fresh tissue for grafting. From our various observations we believe that a graft is more apt to be successful if it is viable when implanted.

The factor of immunological reaction between graft and host is exceedingly difficult to evaluate. Our series of heterografts is small and no conclusions can be drawn therefrom. However it was a distinct surprise to find that any of the grafts from one species to another would survive. Indeed the microscopic structure of the grafts which were transferred from hog to dog showed better preservation of the media than was the case in any of the dog to dog homografts. The grafts from baboon to dog on the other hand were very poor both grossly and microscopically. This raises the interesting possibility that the transplantation of heterografts between certain species may be practical. If it could be proved, for example, that vessels of sheep, dog, or hog could be used successfully in human beings, we could have available a relatively convenient source of blood vessel grafts. The successful transplantation of fresh dog arteries to the femoral artery in 3 human beings is being reported by Oudot (26) from Paris. He stated in a personal communication (27) that dog vessels were used rather than human arteries because French law prohibits autopsy (and any chance of procuring vessels from a dead body) until 24 hours postmortem. He was able to demonstrate, by arteriography, that the dog vessel grafts were patent, but he did not state how long after operation these roentgenographic studies were made.

While our laboratory experiences convinced us of the dependability of homografts—as far as dog to dog is concerned—there is, of course,

we have had some measure of success with small series of 15 grafts which we definitely know to be nonviable. These grafts were stored in 4 per cent neutral formalin for from 30 to 150 days, were rinsed thoroughly in buffered salt solution, and implanted into recipient animals. All grafts carried blood well for several months, but roentgenograms of some of these show calcification in the graft walls.

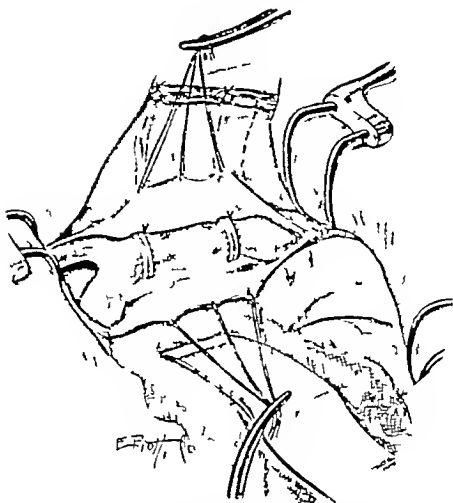


Fig. 8. Treatment of coarctation of the aorta (Case 9) by removal of narrowed segment of aorta and insertion of a human aortic graft. The graft had been procured from a human who had died in an automobile accident, it had been preserved for 28 days in 10 per cent human serum in balanced salt solution at 1 to 4 degrees C before insertion into the recipient patient. The graft was 5 centimeters in length.

graft, which had been preserved 1 day was placed between the right subclavian artery and the side of the right pulmonary artery. Dicumarol therapy was given postoperatively on the tenth day bleeding began from the nose, mouth gastrointestinal tract into the right pleural cavity and manifestations of intracranial neurological disturbances appeared. Because the blood in the right side of the chest could not be satisfactorily aspirated a thoracotomy was performed on March 16, 1948 to remove clots. The child died the following day largely from the neurological complications of the anticoagulation therapy. Postmortem examination showed the graft and shunt to be patent and in good condition without evidence of leakage or thrombosis. The thoracic bleeding had apparently come from the musculature of the chest wall.

CASE 4. L. B. a 12 year old girl had been cyanotic since the age of 3 to 4 months. She was barely able to climb one flight of stairs. On physical examination there was marked cyanosis, advanced clubbing

and a systolic murmur of considerable intensity in the pulmonic area. Roentgenograms and electrocardiograms were consistent with a tetralogy of Fallot. The red blood count was 8.7 million. At operation on May 1, 1948 a graft which had been preserved for 4 days, was implanted between the proximal end of the left subclavian artery and the side of the left pulmonary artery. The child's color was greatly improved for about 24 hours but she then developed congestive heart failure and died on the second postoperative day. A continuous murmur was heard until death occurred. At autopsy the graft was found to be intact and also to be free of thrombosis.

CASE 5. H. B. a 13 year old boy was first noted to have persistent cyanosis at the age of 6 years. He was forced to squat and rest after short periods of walking. Physical examination showed moderate cyanosis, well marked clubbing of the fingers and toes and a loud systolic murmur over the pulmonic area. Roentgenograms of the chest and electrocardiograms

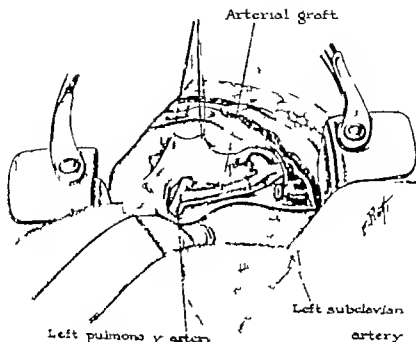


Fig. 7. Treatment of tetralogy of Fallot (Case 3) by insertion of human arterial graft between the left pulmonary artery and the proximal end of the left subclavian artery. (Patient had right aortic arch and an innominate artery on the left.) The graft had been secured from another human and had been preserved for 14 days before insertion into the recipient patient.

used to repair an aortic defect after excision of a coarctation. A brief summary of each case follows.

**CASE 1. D. E.** a 5 year old boy had been cyanotic since birth and had great limitation of physical activity. On physical examination there was marked cyanosis of the fingers and toes and a harsh systolic murmur in the pulmonary area. Roentgenograms of the chest gave findings typical of a tetralogy of Fallot. Electrocardiograms showed right axis deviation. The red blood count was 7.6 million. At operation on February 6, 1948 a 3 centimeter segment of (adult) iliac artery which had been preserved for 3 weeks, was sutured into place between the left pulmonary artery and the proximal end of the left subclavian artery. During the 5 months since operation the child has had great alleviation of his cyanosis and has had a marked increase in his tolerance for exercise. The red blood count has fallen to 5.5 million. There is a continuous murmur in the pulmonary area of the precordium.

**CASE 2. W. P.** a 4½ year old child, deeply cyanotic since birth, had had a right-sided hemiplegia since the age of 2, this neurological damage being presumably on the basis of thrombosis of intracranial

vessels. A faint systolic murmur was audible in the pulmonary area. The red blood count was 9.8 million and the hematocrit was 87 per cent. He had insufficient strength to do more than sit in bed. Roentgenograms and electrocardiograms were typical of a tetralogy of Fallot; the aortic arch was on the right. At operation on February 11, 1948, a human arterial graft 2.5 centimeters long which had been preserved for 14 days was sutured in place between the proximal end of the left subclavian artery and the side of the left pulmonary artery (Fig. 7). During the 5 months that the boy has been followed since operation his general condition has been dramatically improved. The red count has fallen to 5.8 million. He can now walk considerable distances and has a marked alleviation of his cyanosis. A continuous murmur is audible in the left second intercostal space anteriorly.

**CASE 3. S. F.** a 10½ year old girl, had been cyanotic since birth, and was able to walk only 75 yards at a time. Auscultation revealed a pulmonary systolic murmur of moderate intensity. Roentgenograms, electrocardiograms and cardiac catheterization all gave findings which were compatible with a tetralogy of Fallot. The aortic arch was on the right. At operation on March 2, 1948 a human arterial

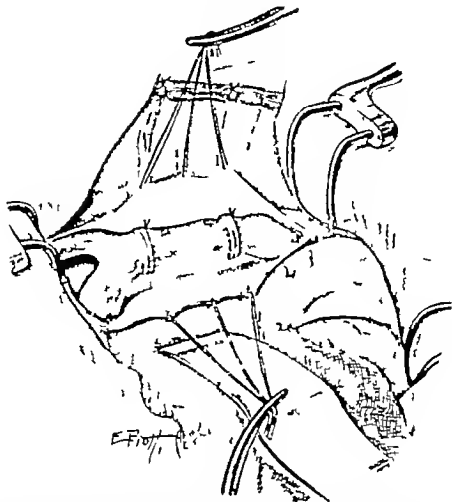


Fig. 8. Treatment of coarctation of the aorta (Case 9) by removal of narrowed segment of aorta and insertion of a human aortic graft. The graft had been procured from a human who had died in an automobile accident. It had been preserved for 28 days in 10 per cent human serum in balanced salt solution at 1 to 4 degrees C. before insertion into the recipient patient. The graft was 5 centimeters in length.

graft, which had been preserved 1 day, was placed between the right subclavian artery and the side of the right pulmonary artery. Dicumarol therapy was given postoperatively on the tenth day bleeding began from the nose, mouth, gastrointestinal tract, into the right pleural cavity, and manifestations of intracranial neurological disturbances appeared. Because the blood in the right side of the chest could not be satisfactorily aspirated, a thoracotomy was performed on March 16, 1948, to remove clots. The child died the following day, largely from the neurological complications of the anticoagulation therapy. Postmortem examination showed the graft and shunt to be patent and in good condition without evidence of leakage or thrombosis. The thoracic bleeding had apparently come from the musculature of the chest wall.

CASE 4. L. B., a 12 year old girl, had been cyanotic since the age of 3 to 4 months. She was barely able to climb one flight of stairs. On physical examination there was marked cyanosis, advanced clubbing

and a systolic murmur of considerable intensity in the pulmonary area. Roentgenograms and electrocardiograms were consistent with a tetralogy of Fallot. The red blood count was 8 million. At operation on May 1, 1948, a graft, which had been preserved for 4 days, was implanted between the proximal end of the left subclavian artery and the side of the left pulmonary artery. The child's color was greatly improved for about 24 hours but she then developed congestive heart failure and died on the second postoperative day. A continuous murmur was heard until death occurred. At autopsy the graft was found to be intact and also to be free of thrombosis.

CASE 5. H. B., a 13 year old boy, was born with persistent cyanosis at the age of 6 months. He was forced to squat and rest after short periods of walking. Physical examination showed marked cyanosis, well marked clubbing of the fingers, and a loud systolic murmur over the pulmonary area. Roentgenograms of the chest showed a large heart and

ere consistent with a diagnosis of tetralogy of Fallot. The red blood count was 6.2 million. At operation on May 3, 1948 a segment of human aorta 4 centimeters long (from a 5 year old child) which had been preserved 6 days was sutured in place between the side of the descending aorta and the side of the left pulmonary artery. Postoperatively a continuous murmur is audible over the pulmonary area. In the month since operation was performed this boy has progressed extremely well; his color is greatly improved; his physical activity is strikingly increased and the red blood count has fallen to 5.2 million.

CASE 6. R. D. is a 1 year old boy who had been intensely cyanotic since birth. His activity had been so severely limited that he was barely able to ascend on slight flights. Physical examination showed marked cyanosis and clubbing of the fingers and toes, a loud murmur over the pulmonary area. Roentgenogram, electrocardiograms, and cardiac catheterization were interpreted as indicating that the patient had a stenosis of the tricuspid valve with a associated large interauricular septal defect. The pulmonary blood flow was believed to be insufficient. At operation on May 6, 1948 a segment of human aorta (from a 5 year old child) which had been preserved 9 days was interposed as a bridge between the side of the descending aorta and the side of the left pulmonary artery. Postoperatively there is a continuous murmur in the pulmonary area. In the month since operation the boy has had an excellent improvement in color and in tolerance for physical activity.

CASE 7. A. H. was a 7 year old boy who had exhibited rather constant cyanosis since birth and had had frequent spells of fainting without definite evidence of cerebral thrombosis. He had a low tolerance for exercise and frequently assumed a squatting position. On examination there was marked cyanosis, clubbing of the fingers and a loud systolic murmur in the third left interspace. Electrocardiograms showed a marked right axis deviation and fluoroscopic findings were not those consistent with tetralogy of Fallot. At operation on May 17, 1948, the pressure in the left pulmonary artery—although not actually measured—was obviously much greater than in most cases of tetralogy and it was very doubtful if the aorta-pulmonary artery shunt would be of value. However it was decided to attempt such an anastomosis. Because the vessels lay in positions which precluded direct anastomosis, a graft 3 centimeters in length (which had been preserved 20 days) was sutured into the side of the descending aorta and its opposite end sewed end-to-side into the pulmonary artery. Only a questionable thrill could be felt in the graft when the clamps were removed, the pulmonary artery pressure was so high that probably little if any blood flowed through the anastomosis. Following operation the boy showed no important changes in color or activity; only a systolic murmur could be heard in the pulmonary area. He was discharged home unimproved. We believe that the

failure to produce beneficial changes in this case was due not to thrombosis of the graft, but to the fact that the child has some sort of a cyanotic state (such as an Eisenmenger complex) which is not benefited by an aorta-pulmonary shunt.

CASE 8. R. A. was a 12 year old boy who had been cyanotic since birth. There had been moderate limitation of activities, spells of weakness and frequent squatting on his haunches. On examination there was moderate cyanosis, a very loud systolic murmur in the pulmonary area and mild clubbing. The hemoglobin was 25.8 grams and the hematocrit was 71 per cent. The electrocardiogram showed a right-axis shift. Cardiac catheterization and fluoroscopic examinations indicated the presence of a tetralogy of Fallot. At operation on May 19, 1948 the left subclavian artery was turned downward but in spite of the fact that the left pulmonary artery was divided (and its distal end turned upward) these two ends of vessel could not be brought together for anastomosis. Therefore, a graft 4 centimeters long (which had been preserved 35 days) was inserted end-to-end between the left subclavian artery and the distal end of the left pulmonary artery. Following operation the boy made an excellent recovery. By the time of hospital discharge the hemoglobin had fallen to 16 grams. Since the operation was carried out there has been a loud, continuous murmur in the pulmonary area, the boy's color has greatly improved and even though the period of postoperative observation is only 7 weeks it is already obvious that his exercise tolerance is increased.

CASE 9. D. S. was a 7 year old boy who entered the hospital for treatment of coarctation of the aorta. Examination showed a pressure in the arms varying on multiple readings from 130 to 150 millimeters of mercury systolic. No femoral pulsations could be felt, and no blood pressure readings could be obtained in the legs. A systolic murmur of moderate intensity was heard in the precordium. By fluoroscopy the heart was slightly enlarged. At operation on May 23, 1948 a coarctation of the aorta was found about 2.5 centimeters below the origin of the left subclavian artery. The narrowed portion was excised and it was found to have a lumen of only 3 millimeters in diameter. The remaining ends of the aorta could be brought together only with great tension; it was therefore decided to insert a graft. This graft was a segment of aorta removed from a human 38 days previously. It measured 5 centimeters in length. The anastomoses to the aorta above and to the aorta below were made with continuous mattress stitches of silk, piercing the entire thickness of the vessel walls and everting the ends of the vessels (Fig. 5). The anastomoses could be made without the slightest tension. The patient had an uninterrupted convalescence. Following operation there was an excellent pulsation in the arteries of the legs. By the end of the second postoperative week the arm pressures had fallen to 105 millimeters of mercury systolic and the leg pressures had risen to 135 millimeters of mercury systolic.

## SUMMARY

A method for the preservation of arterial segments is described. This consists in the storage of vessels at temperatures just above freezing and immersed in a mixture of 10 per cent homologous serum in a balanced salt solution to which are added a buffer, a pH color indicator, and streptomycin and penicillin. Vessels to be stored in this manner have been removed from donor animals between 1 and 6 hours after death and have been kept for periods of as long as 42 days before they were successfully transplanted into other dogs. Tissue culture studies have shown that viability is maintained for 35 to 40 days in blood vessels stored in this way.

On the basis of these laboratory investigations segments of arteries or aortas have been secured from humans who have died suddenly and without sepsis. These vessels have been stored in the manner described and have subsequently been used for human patients when the need arose to bridge gaps in large arteries. Segments of such preserved arteries or aortas have been grafted into 9 human subjects with results which are very promising and which certainly merit further trial and study.

Since completion of this manuscript, 6 more grafts have been inserted into humans. One of these has been used in the treatment of a tetralogy of Fallot and the other 5 were inserted into the aorta after removal of coarctations. These have been in place from 3 to 9 months and all are still patent.

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# TESTOSTERONE PROPIONATE IN THE TREATMENT OF ADVANCED CARCINOMA OF THE BREAST

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**R**ADICAL amputation of the breast is the only known method of treatment which offers the prospect of cure for carcinoma of this organ and is followed by excellent results when the operation is well done and the lesion is still limited to the breast. That it fails in many instances due primarily to the extent of the lesion when the patient is first seen is a common experience in every surgeon's practice and has led to the employment of certain therapeutic adjuncts to radical amputation, the most frequently used of which is x-ray therapy. An other adjunct of a more controversial nature which has found intermittent favor over the last fifty years is the production of hormonal imbalance. This has been produced by surgical castration, by irradiation of the ovaries, and more recently by the administration of the male sex hormone, testosterone propionate.

There is considerable laboratory evidence to support the theory that both the estrogens and androgens influence the course of mammary cancer. The administration of estrogenic substances frequently has been shown to result in the formation of mammary cancers in both male and female animals, while Nathanson and Anderson reported that administration of the androgen, testosterone propionate, prevented the development of spontaneous breast tumors in cancer-bearing strains of mice. Loeser found that the implantation of testosterone propionate pellets in cancer strains of mice reduced the mortality due to spontaneous cancer from 75 per cent in the controls to 40 per cent in the treated animals.

There has been little clinical evidence to prove that the administration of estrogens, in spite of their widespread and often indiscriminate use, ever results in the production of cancer of the human breast or that the administra-

tion of androgens to patients who have cancer of the breast results in any permanent benefit.

## REVIEW OF THE LITERATURE

In 1941 Loeser first reported the use of testosterone propionate in the treatment of cancer of the human breast. He reported 5 cases. Three of these were said to be free of the disease at the time the pellets were implanted and remained well for 4 years. In 2 cases where the disease was present no regression was noted although there was systemic improvement and relief from pain.

In 1939 Farrow treated a series of 33 cases with skeletal metastases seen on the breast service at Memorial Hospital in the city of New York. Testosterone propionate was given in doses of from 5 to 25 milligrams for a total of from 6 to 12 injections. Temporary relief from pain with general improvement in the patient was noted in about half the cases. No patient showed clinical or radiographic evidence of control of the disease and all patients were dead at the time of the report made in 1944.

In 1946 Adair and Herrmann reported their studies on the treatment of 11 cases of advanced carcinoma of the breast. Four of these

one with soft part and three with osseous metastases, manifested remarkable improvement which consisted in regression of the primary lesion and soft part metastases in the one and an increase in calcification in areas of osseous metastases in the other three. Four other cases did not respond to treatment while the remaining cases were still under treatment without clinical evidence of improvement. Each of these patients received from 2000 to 4100 milligrams over a period of 2 to 3 months. None of the patients had been observed for longer than 3 months.

Boger reported the case of a 27 year old woman who was bedridden with extensive me-

From the Tumor Clinic and the John C. O'Leary Memorial Research Foundation of the St. Margaret Memorial Hospital.

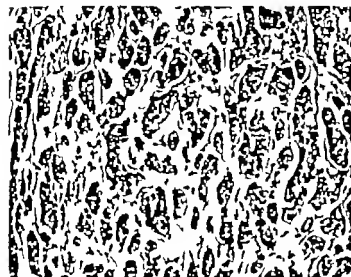


Fig 1. Case 1. A. McC. Photomicrograph of cutaneous metastasis before testosterone therapy.  $\times 80$ .



Fig 2. Case 1. A. McC. Photomicrograph of cutaneous metastasis after 3000 milligrams of testosterone.  $\times 80$ .

tastases from a cancer of the breast. Surgical castration followed by the administration of 1440 milligrams of methyl testosterone orally resulted in relief from pain and partial recalcification of extensive bone lesions of the spine and pelvis. The relief persisted for 8 months but death occurred 4 months later.

Schwander and Marvin used testosterone in 5 cases with soft tissue metastases in doses up to 1425 milligrams and noted symptomatic relief of pain and an increased sense of well being. Moderate doses had no beneficial effect on the primary lesion or on soft tissue metastases although the results suggested

that recalcification of osteolytic metastases occurred with adequate therapy.

Herrmann, Adair and Woodard subsequently reported 11 additional cases with osseous metastases. Three of these had received prior irradiation of the lesions without relief from pain. The others were treated solely with testosterone. Symptomatic improvement occurred in 8 patients within 2 weeks after the onset of therapy. The favorable results were obtained with smaller amounts of testosterone than were used in the cases they had previously reported dosages of 100 milligrams triweekly being found effective.



Fig 3. Case 3. J. J. Roentgenogram showing metastasis to right humerus with pathological fracture at time of first admission to the hospital.



Fig 4. Case 3. J. J. Calcification and bony union in pathological fracture following 2400 milligrams of testosterone.



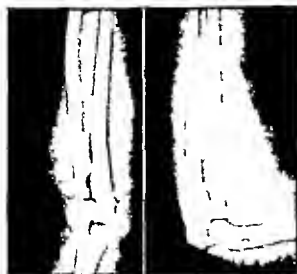


Fig. 5. Case 4. F. S. Roentgenogram showing metastasis to shaft of right radius which appeared after patient had received 3150 milligrams of testosterone.

Herrman and Adair (8) reported 10 cases with soft tissue metastases. One patient showed marked regression of the primary lesion with disappearance of axillary and supraclavicular metastases after the administration of 3150 milligrams over a period of 2 months. She died of the disease 9 months after the start of treatment. Three others showed cytologic alterations of hydropic changes in cytoplasm and pyknosis of nuclei. There was no gross evidence of regression of the lesions, and all died. The 6 remaining patients showed no response to treatment.



Fig. 6. Case 5. S. D. Photomicrograph of axillary metastases removed at time of radical operation.  $\times 80$ .

The most optimistic report was that of Prudente from Sao Paulo, Brazil. In 1945 he reported a series of 63 patients with carcinoma of the breast treated since 1939 by radical amputation followed by prolonged prophylactic administration of testosterone propionate in doses of 175 milligrams per week. Comparing them with a series of 64 patients treated prior to 1939 without the use of testosterone, he concluded that there was an improvement in the survival rate among the testosterone-treated patients of approximately 100 per cent.

#### REPORT OF CASES

**CASE 1.** In the fall of 1946, one of us (J.R.W.) was asked to see a white female, A. McC., aged 50 years, who had cutaneous metastases of the chest wall secondary to a carcinoma of the breast. Five years previously she had had a radical amputation of the left breast performed in another city for a carcinoma. Operation was followed by a course of ray therapy, and a year later by the intrauterine use of radium to induce an artificial menopause. Four years after her original operation she had had a second course of ray therapy for cutaneous metastases, and a year later, rather extensive excision and plastic repair of the involved area which was preceded and followed by a course of Goldblatt's serum. Physical examination 3 months after her last operation revealed a nodular left radical mastectomy scar with presence of several cutaneous metastases over the left anterior and scapular regions. The chest wall bilateral metastatic invasion of the supraclavicular lymph nodes and lymphatics secondary to radiation therapy. One of the cutaneous metastases had broken down and as a result an indolent ulcer about 2 centimeters in diameter had



Fig. 7. Case 1. Photomicrograph of metastases to lymph node of chest wall after testosterone.  $\times 80$ .

formed. The patient knew the nature of her disease and both she and her husband were desperate in their search for help.

Testosterone propionate therapy was discussed with them and finally started at their insistence and with their full knowledge as to the uncertainty of the results as well as to the expense involved. She received 400 milligrams per week for a period of 8 weeks after which the dosage was reduced to 50 milligrams every other week. Two weeks after the institution of therapy she stated that she felt better and thereafter for nearly 3 months the improvement was rapid and sustained. Her appetite improved, she gained weight and strength and had almost complete relief from pain not only from the pain of the metastases but interestingly enough relief from the arthritic pain in her knees and right shoulder which she had had for years. She discarded the cane which she frequently used and changed from an invalid to an energetic woman even taking a thousand mile auto trip every minute of which she enjoyed. The skin metastases also appeared to be altered having taken on a dull cyanotic cast and apparently having diminished somewhat in size although there was no tendency of the ulcer to heal. The greatest change of all was in her mental attitude for she was convinced that she was going to get well.

Three months after the institution of treatment she began to fail. Histologic sections of cutaneous metastases before and after testosterone therapy showed no change (Figs. 1 and 2). There was a gradual increase in the size as well as number of the cutaneous metastases some of which broke down to form other ulcers. A tumor clinically typical of a rapidly growing carcinoma appeared in the other breast and she died with extensive cutaneous and visceral carcinomatosis 8 months after the start of treatment.

Stimulated by the early changes which occurred in this patient the problem was submitted to the Tumor Clinic at St. Margaret Memorial Hospital where it was agreed to carry out further investigation on the use of testosterone propionate in the treatment of cases of advanced carcinoma of the breast. This is a report of the above case plus 6 additional cases followed in the Tumor Clinic. The expenses of the investigation were born by the John C. Oliver Research Foundation of the hospital.

In all 7 cases were studied. Four of these were patients who had operable carcinoma of the breast with proved axillary metastases and were treated by radical amputation of the breast and the administration of testosterone. Two had inoperable carcinoma with skeletal metastases while the seventh case

was the one here described with recurrent carcinoma following prior radical amputation.

Testosterone propionate (perandren) was administered intramuscularly in doses of 200 to 250 milligrams twice a week for a total of 3000 milligrams. It was then reduced to 50 milligrams every other week and continued until the condition of the patient indicated that the disease was progressing in spite of its use or until the patient died. Exceptions to this were 2 patients in whom treatment was stopped approximately 6 months following radical amputation and who appeared to be well. One patient died early in the course of treatment having received 1200 milligrams of the drug which ranged from 3000 to 3900 milligrams. Where possible cutaneous or lymph node metastases were removed after the administration of at least 2000 milligrams of testosterone for microscopic comparison with the original lesions.

CASE 2. E. K., a white female aged 37 years was presented to the Tumor Clinic because of a mass in the right breast of unknown duration. Her chief complaint was pain in her joints and back which had been present for about 2 years. On physical examination she was found to have a large tumor in the breast with palpable axillary lymph nodes. There was x-ray evidence of metastases to the lumbar spine, pelvis and left femur. There was moderate secondary anemia. An axillary lymph node was removed for microscopic examination and was reported as a metastatic adenocarcinoma. Broders grade four. Testosterone propionate was started in doses of 200 milligrams twice a week. This was followed by an apparent decrease in the size of the remaining axillary lymph nodes. A gain of 4 pounds in weight and sufficient relief from pain to permit her to walk into the out-patient department instead of being brought in in a wheel chair. She died 1 month after the start of treatment with the clinical signs and symptoms of a cerebral metastasis. She had received 1200 milligrams of the drug.

CASE 3. J. J., a white female aged 63 years was admitted to the hospital as an emergency case with a fracture of the right humerus as a result of a minor trauma. On physical examination she was found to have in addition to the fracture a tumor in the left breast which measured approximately 6 centimeters in diameter together with enlargement of the axillary lymph nodes. She stated that she had known of the presence of the tumor for at least 3 years but had consulted no one about it because it was not producing any symptoms. A ray examination of the skeletal system showed osteolytic lesions in the head and neck of the left femur, the left ilium

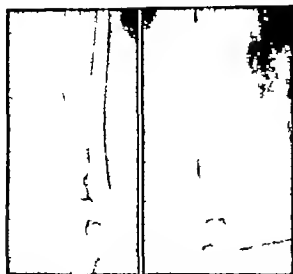


Fig. 4. Case 4. L. S. Roentgenogram showing metastases in shaft of right radius both appeared after patient had received 1350 milligrams of testosterone.

Herrman and Adair (6) reported 10 cases with soft tissue metastases. One patient showed marked regression of the primary lesion with disappearance of axillary and supraclavicular metastases after the administration of 3150 milligrams over a period of 2 months. She died of the disease 9 months after the start of treatment. Three others showed cytologic alterations of hydropic changes in cytoplasm and pyknosis of nuclei. There was no gross evidence of regression of the lesions, and all died. The 6 remaining patients showed no response to treatment.



Fig. 6. Case 5. S. D. Photomicrograph of axillary metastasis removed at time of radical operation. X 80.

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Fig. 7. Case 5. S. D. Metastatic lymph node of chest wall after 3000 milligrams of testosterone. X 80.

milligrams given twice a week until the patient had received 3000 milligrams and then reduced to 50 milligrams every other week. This was carried out under the supervision of her family physician and was finally stopped after a total of 3500 milligram had been given, and the patient was apparently well. She remained well for 11 months when cutaneous metastases began to appear in large numbers over the chest wall. She refused any further therapy and died 16 months after operation.

CASE 7. E. G. a white female aged 45 years had known of the presence of a gradually enlarging tumor in the left breast for 18 months. Highly intelligent in all other respects she had consulted no one about it because she feared it might be a cancer. Her physical examination was entirely negative save for the breast lesion which measured 3 centimeters in diameter and for the presence of palpable axillary lymph nodes. Laboratory studies including blood calcium, phosphorus and alkaline phosphatase determinations were all within normal limits. Radical amputation of the breast was carried out the lesion being reported to be a Broders grade three adenocarcinoma with axillary metastases. This was followed by the administration of 250 milligrams of testosterone propionate twice a week for a total of 3000 milligrams and then 50 milligrams every other week until she had received 3400 milligrams. Menstruation ceased shortly after the beginning of treatment and did not reappear until a month after the last injection. She felt well and had no disturbing reactions except for a slight deepening of her voice which was somewhat embarrassing to her in her occupation as a store executive. Medication was discontinued 6 months after operation. She is apparently well with out evidence of recurrence 18 months after operation.

### RESULTS

In this series of cases the administration of testosterone appears to have had no curative and little inhibitory effect on the disease or its course. Six of the 7 patients treated have died of the disease within 16 months of the institution of treatment. Four of the 7 patients had radical mastectomy for operable carcinoma of the breast with axillary metastases. Three of these are now dead and one is living and apparently well. This is too small a group to have any statistical significance, although the result is no better than that obtained by radical amputation alone. In 2 inoperable cases with bone metastases, there was prompt relief from the pain of such lesions while in 1 of these union of a pathological fracture occurred within 6 weeks. No permanent effect was noted on soft tissue metastases. In 3 patients there appeared to

TABLE I—SUMMARY OF CASES

Number of cases treated	7
Operable carcinoma with axillary metastases	4
Inoperable carcinoma	3
Recurrent carcinoma	1
	<hr/>
Treatment	7
Radical amputation—testosterone	4
Bioopsy—testosterone.	3
	<hr/>
Results	7
Operable cases	
Living and well without recurrence	1
Died of disease	3
Inoperable and recurrent cases	
Living	0
Died of disease	3
	<hr/>

be a slight decrease in the size of metastatic lesions to the skin or axillary nodes but this was a best of temporary duration and the observation is subject to question. In one instance this apparent decrease was associated with a change in the color of several skin metastases from flesh color to a dusky red but they soon faded again and ultimately broke down to form ulcers. Microscopic examination of soft tissue lesions before and after treatment in 2 cases failed to show any unusual changes in the appearance of the tumor cells which could be attributed to testosterone. Distant metastases to the liver and brain occurred during treatment while 1 patient developed a rapidly growing carcinoma in the remaining breast.

Laboratory tests carried out before and during the course of treatment revealed no significant alterations in blood counts, urinalysis, blood calcium, phosphorus or alkaline phosphatase studies.

All patients noted an improved sense of well being so marked in several instances that they volunteered the information that they felt better than they had for years and that their friends remarked on how much better they looked. This improvement appeared within 2 to 3 weeks of the institution of treatment was most pronounced in those patients showing the greatest debility and persisted for a variable period of from 2 to 5 months. There was an increase in body weight, appetite and strength and a marked improvement in the mental attitude of those

and the upper portion of the right humerus with a pathological fracture in the latter. Laboratory studies were as follows: red blood cells 5,120,000; hemoglobin 95 per cent; blood calcium 10.3 milligrams; phosphorus 3.0 milligrams; alkaline phosphatase 4.58 Bodanski units; urine, normal. An axillary lymph node was removed for pathologic examination and was reported as a Broders grade three adenocarcinoma of breast origin. The fracture was immobilized by means of an abduction splint and testosterone propionate was started in doses of 25 milligrams twice a week. Six weeks after the institution of treatment, the patient returned to the hospital for examination. She had discarded the orthopedic appliance and was using her right arm to feed herself and to comb her hair. She stated that she felt better than she had for the last 5 years and that her friends all commented on how well she appeared. X-ray studies revealed evidence of calcification (Figs. 3 and 4) of the bony lesions with union of the fracture of the right humerus. The dosage of testosterone was reduced to 50 milligrams every other week. As the patient lived in a distant town she was not seen again although periodic reports indicated that the improvement was maintained until 3 weeks before death when she became jaundiced as a result of liver metastases, and lapsed into coma. She had had very little pain even in the terminal phase of the disease. Her death occurred 6 months after the institution of treatment. She had received 3500 milligrams of testosterone.

CASE 4. E. S. a white female aged 41 years was seen in the Tumor Clinic because of the presence of a tumor in the left breast which she had had for 14 months, having first noticed it during the second month of a pregnancy. She went through the pregnancy and was delivered of a normal healthy infant at term. The breast tumor had not been noted by her obstetrician nor did she call any attention to it until 7 months after delivery when she became alarmed because of its increase in size. On examination the tumor was found to measure approximately 5 centimeters in diameter. The lymph nodes in the axilla were enlarged. A blood count and urinalysis were normal. Radical amputation of the breast was performed; the pathologist reporting the lesion to be a Broders grade two adenocarcinoma in a lactating breast with involvement of the axillary lymph nodes. Two hundred milligrams of testosterone were given 1 week after operation and this dosage was continued twice a week for a total of 3000 milligrams. It was then reduced to 50 milligrams every other week. Menstruation ceased after the second injection. The patient repeatedly volunteered the information that she felt fine and her sole complaints were that her voice seemed to have deepened a little and that she occasionally had vague pain in the region of the lower dorsal spine. X-ray studies of the chest, ribs, and spine were negative. Three months after the beginning of treatment she complained of pain and swelling (Fig. 5) in the right forearm just below the elbow and x-ray examination of the area

revealed a bone metastasis to the shaft of the radius. Because it had appeared while she was still receiving testosterone x-ray therapy was used with prompt relief from pain and with evidence of recalcification of the lesion. Ten months after operation she was readmitted to the hospital because of falling vision. An x-ray of the skull was negative but there was clinical evidence of a cerebral lesion, probably of metastatic origin. She died 3 months later. She had received testosterone for the entire year the total dosage being 3900 milligrams.

CASE 5. S. D. a white female aged 53 years, was sent to the Tumor Clinic because of a tumor of the left breast which had been present for a year. She had passed through the menopause at the age of 31 years. Physical examination revealed an inflammatory carcinoma involving the entire left breast with palpable axillary lymph nodes. There was no other evidence of extension of the disease, either on physical examination or on x-ray examination of the chest. The lesion was considered to be operable. Laboratory studies showed 4,000,000 red blood cells and 93 per cent hemoglobin. Urinalysis was negative. The blood calcium was 7.3 milligrams and the phosphorus 88 milligrams. The alkaline phosphatase was recorded as 3.63 Bodanski units. Radical amputation of the breast was performed for a Broders grade four adenocarcinoma with axillary metastases and was followed by the administration of testosterone propionate in dosages of 300 milligrams twice a week.

There was a gain in weight and a sense of well-being. A macular rash appeared on her body but lasted for only a week and disappeared without local treatment and without stopping the drug. After the patient had received 2000 milligrams of testosterone, it was noted that there was an enlargement of the left supraclavicular lymph node together with skin metastases on the chest wall (Figs. 6 and 7) one of the latter of which was removed for microscopic examination. Histologic examination of this tumor showed considerable change in the appearance of the tumor chiefly fibrous but with some degeneration of essential cells. This change was not considered specific for testosterone therapy. Testosterone therapy was continued until the patient had had a total of 3150 milligrams. She ultimately developed metastases to the liver associated with severe pain and died 8 months after operation.

CASE 6. A. F. a white female aged 64 years, was admitted to the hospital because of diabetes mellitus and the presence of a tumor in the right breast. Physical examination was essentially negative save for generalized arteriosclerosis, the presence of a tumor in the breast which measured 3 centimeters in diameter and palpable lymph nodes in the right axilla. There was three plus sugar in the urine and a blood sugar level of 338 milligrams. After adequate control of the diabetes had been obtained radical amputation of the breast was performed. The pathologist reported the tumor to be a Broders grade three adenocarcinoma with axillary metastases. Testosterone propionate was started in doses of 150

he accelerated by three types of stimuli stresses and strains diet and hormones and other chemical and enzymatic substances that both estrin and testosterone are effective stimulants and that their administration resulted in an increased rate of bone repair. Gardner and his associates think that testosterone may find a practical application in the prevention or alleviation of the symptoms of senile osteoporosis and in the acceleration of the rate of healing of fractures.

The recent observations that testosterone may be effective in some instances in the treatment of bone metastases from carcinoma of the breast may possibly be explained by the stimulation of bone repair at the site of the metastases rather than to any specific effect on the tumor. It is not logical to assume that cancer cells would be altered when they reside in bone but not when they occur in soft tissue. The relief from the pain of bone metastases in 2 patients in this series as well as the rapid union of a pathological fracture in one of these was thus possibly due to the hormonal stimulation of bone repair.

The temporary duration of the bodily changes which occur following the administration of testosterone has been noted by many observers and apparently is due to the interrelationship between the adrenals, pituitary, and ovaries. Farrow states that any natural or artificial imbalance caused by either the menopause or castration will be followed by compensatory changes in other endocrine organs and a partial replacement by hormones or compounds having a biologic effect similar to that of those which have become deficient and consequently that any imbalance due to excesses or deficiencies of sex hormones may be of a temporary nature. Although our clinical observations would tend to indicate a beneficial effect of many weeks' duration, Kenyon states that the drug may lose its effect in as short a period as 10 days. The appearance of a metastatic bone lesion in 1 patient of this series while under testosterone therapy would tend to indicate the inability of the drug to maintain its effect for any prolonged period of time.

It is possible that the systemic improvement noted following the treatment of 7 pa-

tients with advanced carcinoma of the breast with testosterone propionate was due not to any effect on the tumor cells but rather to the anabolic action of the drug on all the body tissues. It is our belief that it has no place in the management of carcinoma of the breast except as a palliative agent.

#### SUMMARY AND CONCLUSIONS

1 Testosterone propionate in amounts up to 3900 milligrams was used to treat 7 patients with carcinoma of the breast.

2 In 3 patients with inoperable or recurrent carcinoma it failed to alter the course of the disease and all 3 patients are dead.

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4 There was no evidence of any specific alteration in tumor cytology in 2 patients in whom metastatic lesions were removed after the administration of 2000 and 3000 milligrams of testosterone respectively.

5 Systemic improvement consisting of a gain in weight and strength occurred in all cases being most marked in those with the greatest debility. It appeared within 2 to 3 weeks of treatment but was of temporary duration usually lasting for about 3 months.

6 The pain of bone metastases was relieved in the 2 patients who had such lesions when treatment was started while union occurred in the 1 patient with a pathological fracture. One patient developed a painful bone metastasis while under treatment.

7 There is evidence to show that systemic improvement, relief from pain and calcification of bone metastases are due to the anabolic effect of the drug on the entire body rather than to any specific effect on tumor cells that similar improvement occurs when the drug is administered in the presence of other diseases and that it can be explained entirely by the known action of the drug on the normal subject.

8 No evidence was obtained in this series of 7 cases to indicate that testosterone propionate had any specific inhibitory effect on

patients who knew the nature and the prognosis of their disease. Those patients who had pain were relieved during treatment, although they all required narcotics during the terminal stages of the disease.

There were no adverse reactions to the use of testosterone. In those patients in the younger age group menstruation ceased shortly after the institution of treatment. Deepening of the voice occurred but was not marked enough to be annoying or particularly embarrassing. It was not noted in those patients who had passed the menopause. There was no evidence of hirsutism. One patient had a transient acne which persisted for only a short time and disappeared without altering the course of treatment and was accordingly thought not to be due to the testosterone.

#### DISCUSSION

The results obtained in this series of cases have not been encouraging and do not seem to warrant the enthusiasm found in some of the other reports. All 7 cases were examples of carcinoma of the breast with metastases. Three were in an advanced stage of the disease when treatment was begun while the remaining 4 had operable tumors with axillary metastases. In 3 of the operable cases the patients possessed complicating factors such as pregnancy diabetes mellitus or an inflammatory type of tumor all of which are known to give an unfavorable prognosis in this disease. The only operable case in which one of these complicating factors did not exist was Case 7. This is the only patient who is still living. Were testosterone propionate effective in the treatment of carcinoma of the breast some improvement in results should have been apparent regardless of the stage of the disease. This was not the case in spite of the fact that large doses were given and that 5 of the 6 patients who died were still receiving the drug at the time of death. Not only was the ultimate outcome unaffected but microscopic examination of metastatic lesions removed from 3 patients after the administration of 2000 and 3000 milligrams, respectively failed to reveal any alteration in tumor cytology which could be attributed to testosterone.

Three beneficial effects were noted there was a gain in weight and strength with a sense of well-being there was a decrease in pain and there was evidence of calcification of bony metastases. All of these were of temporary duration. It is our impression that they were all due to the action of testosterone propionate on the metabolic processes of the body rather than to any specific effect on tumor cells. There is evidence to support this impression.

Kenyon states that testosterone has an anabolic effect on the body causing a decrease in the urinary excretion of nitrogen, inorganic phosphorus and sulfate, potassium sodium and creatine and that its administration results in an increase in the basal metabolic rate and gain in body weight. He found that 25 milligrams daily is an effective dose if the patient is maintained on a constant diet. Butler and his associates found that a reduction in urinary nitrogen occurred even in the presence of a starvation diet with inadequate caloric intake although a positive nitrogen balance could not be obtained unless the patient was on a diet adequate in calories and protein. Abbott, studying a series of burn cases and noting the effects of diet and testosterone on recovery stated that patients receiving testosterone and an adequate caloric intake did better than those without testosterone or those on an inadequate diet with or without testosterone. He further stated that a reduction in the amount of urinary nitrogen and a gain in body weight occurs following its administration to normal subjects of both sexes and referred to similar observations having been made on patients with carcinoma of the stomach hyperthyroidism Cushing's disease Simmonds disease, pernicious anemia hypogonadism and nephrosis. The amount of nitrogen excreted in the urine could be reduced effectively by giving 12.6 milligrams daily.

Interest has been shown in the effect of hormones on the healing processes of bone. According to Albright the healing of a fracture is a special form of bone metabolism which is dependent on the formation of an organic matrix through the activity of the osteoblasts. He found that this activity could

be accelerated by three types of stimuli: stresses and strains, diet and hormones and other chemical and enzymatic substances that both estrin and testosterone are effective stimulants and that their administration resulted in an increased rate of bone repair. Gardner and his associates think that testosterone may find a practical application in the prevention or alleviation of the symptoms of senile osteoporosis and in the acceleration of the rate of healing of fractures.

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8 No evidence was obtained in this series of 7 cases to indicate that testosterone propionate had any specific inhibitory effect on

patients who know the nature and the prognosis of their disease. Those patients who had pain were relieved during treatment, although they all required narcotics during the terminal stages of the disease.

There were no adverse reactions to the use of testosterone. In those patients in the younger age group menstruation ceased shortly after the institution of treatment. Deepening of the voice occurred but was not marked enough to be annoying or particularly embarrassing. It was not noted in those patients who had passed the menopause. There was no evidence of hirsutism. One patient had a transient acne which persisted for only a short time and disappeared without altering the course of treatment and was accordingly thought not to be due to the testosterone.

#### DISCUSSION

The results obtained in this series of cases have not been encouraging and do not seem to warrant the enthusiasm found in some of the other reports. All 7 cases were examples of carcinoma of the breast with metastases. Three were in an advanced stage of the disease when treatment was begun while the remaining 4 had operable tumors with amylary metastases. In 3 of the operable cases the patients possessed complicating factors such as pregnancy, diabetes mellitus, or an inflammatory type of tumor all of which are known to give an unfavorable prognosis in this disease. The only operable case in which one of these complicating factors did not exist was Case 7. This is the only patient who is still living. Were testosterone propionate effective in the treatment of carcinoma of the breast some improvement in results should have been apparent regardless of the stage of the disease. This was not the case in spite of the fact that large doses were given and that 5 of the 6 patients who died were still receiving the drug at the time of death. Not only was the ultimate outcome unaffected but microscopic examination of metastatic lesions removed from 2 patients after the administration of 2000 and 3000 milligrams, respectively failed to reveal any alteration in tumor cytology which could be attributed to testosterone.

Three beneficial effects were noted there was a gain in weight and strength with a sense of well being there was a decrease in pain and there was evidence of calcification of bony metastases. All of these were of temporary duration. It is our impression that they were all due to the action of testosterone propionate on the metabolic processes of the body rather than to any specific effect on tumor cells. There is evidence to support this impression.

Kenyon states that testosterone has an anabolic effect on the body causing a decrease in the urinary excretion of nitrogen, inorganic phosphorus and sulfate potassium sodium and creatine and that its administration results in an increase in the basal metabolic rate and gain in body weight. He found that 25 milligrams daily is an effective dose if the patient is maintained on a constant diet. Butler and his associates found that a reduction in urinary nitrogen occurred even in the presence of a starvation diet with inadequate caloric intake although a positive nitrogen balance could not be obtained unless the patient was on a diet adequate in calories and protein. Abbott studying a series of burn cases and noting the effects of diet and testosterone on recovery stated that patients receiving testosterone and an adequate caloric intake did better than those without testosterone or those on an inadequate diet with or without testosterone. He further stated that a reduction in the amount of urinary nitrogen and a gain in body weight occurs following its administration to normal subjects of both sexes and referred to similar observations having been made on patients with carcinoma of the stomach, hyperthyroidism, Cushing's disease, Simmonds' disease, pernicious anemia, hypogonadism and nephrosis. The amount of nitrogen excreted in the urine could be reduced effectively by giving 12.6 milligrams daily.

Interest has been shown in the effect of hormones on the healing processes of bone. According to Albright the healing of a fracture is a special form of bone metabolism which is dependent on the formation of an organic matrix through the activity of the osteoblasts. He found that this activity could

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#### SUMMARY AND CONCLUSIONS

- 1 Testosterone propionate in amounts up to 3900 milligrams was used to treat 7 patients with carcinoma of the breast
- 2 In 3 patients with inoperable or recurrent carcinoma it failed to alter the course of the disease and all 3 patients are dead
- 3 In 4 patients with operable carcinoma with axillary metastases administration following radical amputation failed to improve the results ordinarily obtained by radical amputation alone. Three of the 4 patients are now dead
- 4 There was no evidence of any specific alteration in tumor cytology in 2 patients in whom metastatic lesions were removed after the administration of 2000 and 3000 milligrams of testosterone respectively
- 5 Systemic improvement consisting of a gain in weight and strength occurred in all cases being most marked in those with the greatest debility. It appeared within 2 to 3 weeks of treatment but was of temporary duration usually lasting for about 3 months
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#### SUMMARY AND CONCLUSIONS

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advanced carcinoma of the breast that it altered the course of the disease or that it resulted in any improvement in the survival rates obtained by the more commonly accepted forms of therapy

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# THE STUDY OF PERIPHERAL VASCULAR DISEASE WITH RADIOACTIVE ISOTOPES

## Part II

F W COOPER Jr., M D F.A.C.S., DANIEL C ELKIN M D F.A.C.S.  
PATRICK C SHEA, Jr., M D., and E. W DENNIS B.S. Atlanta, Georgia

THE introduction of the use of radioactive isotopes in the study of peripheral vascular disease has made possible the critical evaluation of the circulation in the tissues of the extremities. Although all methods of instrumental investigation have certain inherent weaknesses they contribute a valuable addition to the clinical evaluation of vascular disorders. Studies on the circulation in the muscles of the extremities in normal individuals and those with vascular diseases have made possible a more objective evaluation of the patient.

In a previous report Part I (1) two methods for the use of radioactive sodium 24 in the investigation of circulatory physiology of the extremities were compared and discussed. The electronic apparatus used for these studies was described in detail and the results of one of the study methods were evaluated. This paper is concerned with an evaluation of the results of the second method.

In brief a sterile solution of radioactive sodium chloride consisting of 10 microcuries of the radioactive substance in approximately 0.2 cubic centimeter of solution is injected into the muscle of the extremity to be studied. The radiation effect on the individual from this quantity of radioactive material is negligible and frequent repeated observations can be made without danger to the patient. The radioactive sodium emits strong gamma rays which are readily detected by electronic equipment placed outside the body.

The presence of the sodium chloride in the muscle is recorded automatically by an electromechanical device built for these studies.

(3) As the radioactive salt solution is mobilized into the vascular channels and is removed from the part the decrease in the amount of sodium chloride in the muscle is similarly detected. Since the amount of radioactive salt solution originally injected is small after its mobilization into vascular system and subsequent dilution the amount of radioactive salt returning to the extremity is not significant.

The technique of the procedure consists of placing the patient on a tilt table with the extremities elevated at 35 degrees. A detecting unit (Geiger Mueller tube) is placed posterior to each gastrocnemius muscle. The radioactive sodium chloride is injected into the muscle and its rate of disappearance is measured for a period of 10 minutes. The patient may then be placed in a horizontal position, and a similar determination of the rate of disappearance made. In certain instances drugs have been administered or other measures have been carried out which are believed to enhance the circulation and their influence on the mobilization of the sodium determined. These findings are to be reported later.

Fifty seven normal individuals have been studied by this method. It has been found that under basal conditions the disappearance of sodium from the muscle in a given individual is constant. If the rate of disappearance of the sodium is plotted on semilogarithmic paper a linear expression of the rate of disappearance is obtained. For comparison of results, this linear expression can be converted into numerical terms by an equation first employed by Kety (2)

$$K = \frac{\log C_1 - \log C_2}{-4.343 (T_1 - T_2)}$$

C = counting rate at time T  
C<sub>1</sub> = counting rate at time T<sub>1</sub>

From the Whitehead Department of Surgery Emory University School of Medicine, Emory University Georgia. M. Dennis is a Life Insurance Medical Student Research Fellow.  
This work was supported by the United States Public Health Service and the Medical Department, United States Army.

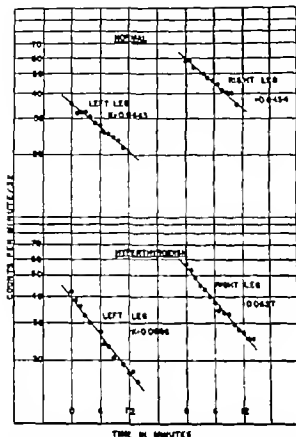


Fig 1 Graph representing the rate of removal of sodium from the extremities in a normal person and in a patient with hyperthyroidism.

In all individuals, many factors control the rate and volume of blood flow to the extremities, for example, the emotional tone of the patient, excitement or apprehension, the activity of the part, the temperature of the environment, and the presence of edema, infection, or metabolic disturbances. Even though a constantly controlled temperature room is used and the patient is observed under basal conditions, only a few of the variables can be eliminated.

It has been found that if the individual is unduly apprehensive the mobilization of sodium will be increased above normal during the initial portion of the examination period and will fall below normal after the apprehension subsides. Consequently it has been found necessary in all individuals to delay the determination of the rate of disappearance for at least 2 or 3 minutes following the injection of

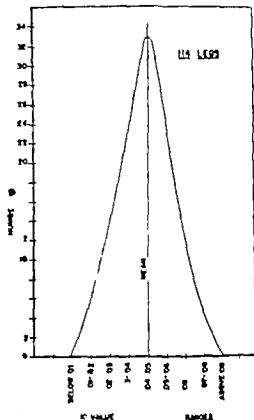


Fig 2 Distribution curve of the results in the study of 114 normal extremities.

the sodium. The patient must be cautioned to remain completely motionless as exercise of the muscle greatly expedites the removal of the sodium and will thus render the determination inaccurate.

From the observation of 114 normal extremities, a disappearance pattern was obtained which varied only within slight limits (Fig 1). The factors, previously mentioned, which produce variations in the disappearance rate of the sodium are included. On plotting these determinations as a distribution curve, the pattern becomes statistically significant (Fig 2).

In individuals of high emotional tone with hypertension or patients with hyperthyroidism, the mobilization of sodium from the muscle has been found to be uniformly increased. Similarly, if hyperemia of the extremity is produced by application and removal of a tourniquet, the mobilization of the sodium can be initially inhibited and then precipitously and abnormally increased in rate. Follow

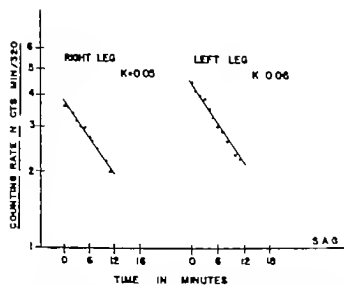


Fig. 3. Graph representing rate of removal of sodium in patient S.A.G. with hypertension blood pressure of 188/126.

ing the application of a venous tourniquet inflated to diastolic pressure the removal of the sodium is prevented.

Patients with obliterative arterial disease and with lesser degrees of vasospastic phenomena will repeatedly produce the most constant pattern of sodium removal. In such individuals the variable factors influencing the blood flow in the extremities are apparently minimized. It is believed that in this group particularly less error would be encountered in the evaluation of specific measures of therapy or operative procedures. Individuals with vascular diseases in which vasospastic phenomena are of more significance demonstrate greater variations during a single period of observation, but they too mobilize sodium at below normal levels seemingly in proportion to the degree of arterial insufficiency.

One hundred and two patients with various vascular changes have been studied. An effort was made to include patients with all types of circulatory abnormalities. Similar curves were obtained on patients with the same vascular disorder. Representative results obtained in individuals with vascular disturbances are presented here.

**Hypertthyroidism.** In the 5 patients with hyperthyroidism the mobilization of the sodium from the extremity was greatly increased (Fig. 1). This might also be expected in patients with increased cardiac output, increased pulse pressure and peripheral vasodilatation.

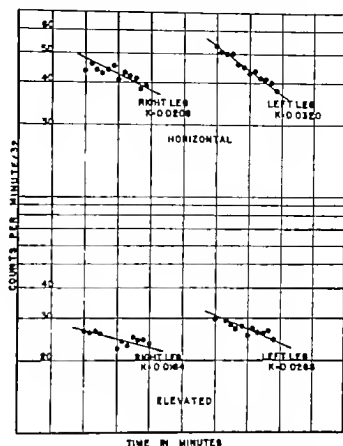


Fig. 4. Graph representing rate of removal of sodium in patient O.D.K. with thrombosis of bifurcation of aorta.

**Hypertension.** Five patients with essential hypertension without congestive failure were studied. These individuals were of high emotional tone, gave an exaggerated response to the Hines and Brown cold pressor test and exhibited marked decline in blood pressure upon sedation. They showed an increased rate of removal of the sodium. Sympathectomy and splanchnicectomy were subsequently performed in each case in an attempt to alleviate the hypertension. Following operation there was no significant change in the rate of sodium removal.

**S.A.G. (Fig. 3).** Hypertension was discovered in this 30 year old white male during a routine examination for admission to the Air Corps 8 years previous to this examination. For 18 months previous to admission he noticed increasingly severe headaches.

Physical examination revealed an elevation of blood pressure to 188/126 in both arms. No cardiac or kidney changes were present. Only slight response to the Hines and Brown cold pressor test was noted. Sympathectomy and splanchnicectomy were performed for the hypertension.

**Arteriosclerosis obliterans.** Twenty patients with varying degrees of arteriosclerotic ob-

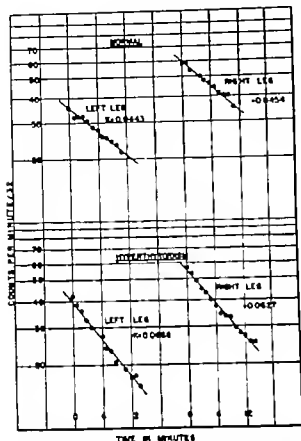


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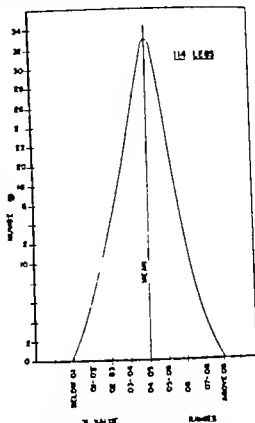


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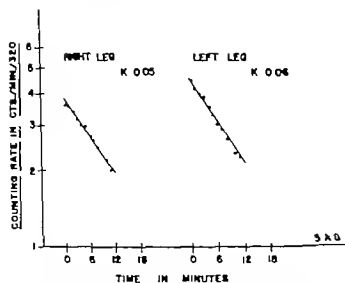


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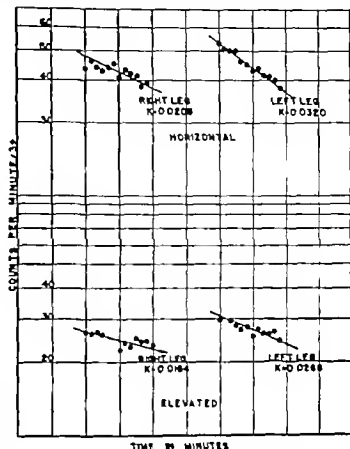


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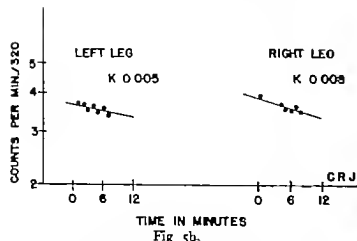


Fig. 5b.

Fig. 5. Patient C.R.J. with arteriosclerosis, popliteal aneurysm and gangrene. a, Graph showing skin temperatures b, graph representing rate of removal of sodium, c, arteriogram showing obstruction of femoropopliteal junction

and no pulsation could be felt in the abdominal aorta below the umbilicus. Skin surface temperatures were normal. Oscillometry revealed greatly diminished pulsations at all levels in the lower extremities.

A diagnosis of thrombosis of the abdominal aorta was made.

C.R.J. (Fig. 5a, b, c.) This 86 year old white male stated that he had been active until 3 weeks prior to admission. An accurate history could not be obtained because of his mental confusion. He was awakened at 2 a.m. at the onset of his present condition with severe pain in the right lower extremity. Shortly thereafter he noticed that his entire foot was cool and that a rubor was present. Cyanosis was present.

Examination of the extremities revealed marked pallor of the right lower extremity on elevation. Both lower extremities became ruborous on dependency. There were trophic changes in the skin and its derivatives in both lower extremities. A small gangrenous plaque was present on the lateral aspect of the right foot at the head of the 5th metatarsal. An area of cyanosis was persistent on the dorsolateral aspect of the right foot when in the horizontal position. The dorsalis pedis and posterior tibial pulses were absent bilaterally. The right popliteal pulse was absent. A popliteal aneurysm was present on the left.

Oscillometric examination revealed pulsations to be absent distal from the knee inferiorly on the right, increased in the left knee region over the aneurysm and diminished at the left ankle. Skin surface temperatures were elevated on the left and normal on the right. An arteriogram (Fig. 5c) was made revealing an obstruction of the femoropopliteal junction.

A diagnosis of arteriosclerosis obliterans and aneurysm popliteal left was made.

E.H. (Fig. 6) a 76 year old white male had a history of a cerebral accident 7 years previous to this examination. Since that time he had suffered from claudications in his legs. There was no history of



Fig. 5c.

trophic changes in the extremities nor did physical examination reveal any such changes. Pallor of the feet was present on elevation. Femoral pulses were palpable but oscillometry did not reveal any pulsations from the knees distally. Skin surface temperatures were diminished bilaterally.

A diagnosis of arteriosclerosis obliterans was made.

**Thrombophlebitis** Twenty-eight patients with thrombophlebitis were studied. This group was by far the most difficult to evaluate. The sodium was found to mobilize more rapidly with the extremity in the elevated position if no arterial insufficiency was present. In this position however the removal rate of the sodium was usually below normal in the edematous extremity and was always less in the affected extremity than in the opposite or normal extremity. The greater the degree of edema of the calf muscle the greater was the retention of the salt solution. It was found also that in general the higher the skin surface temperature the greater was the rapidity of removal. In individuals with high skin surface temperatures the rate of sodium removal was frequently within normal limits.

Even if the extremity had become elephantine in proportion due to an old chronic venous and lymphatic obstruction with extensive fibrosis in the subcutaneous region the mobilization of sodium chloride from the muscle was frequently equal to the rate of mobilization in the uninvolved extremity. This was interpreted as indicating that the



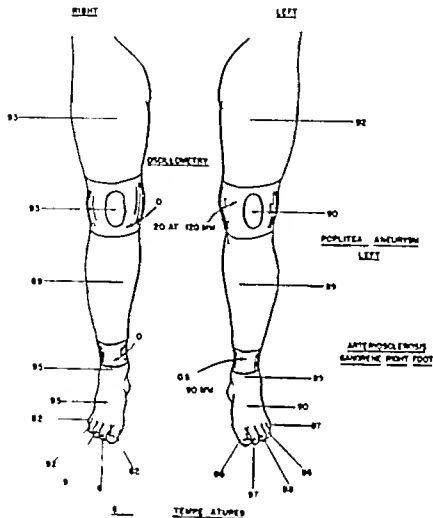


Fig 52

literation of the vascular tree in the lower extremities were studied. It was found that this group of individual had less variation in the rate of sodium disappearance even in the presence of emotional and psychic factors. However, the degree of elevation of the extremity was found to be important in this group. With moderate degrees of vascular obliteration in which the extremity retained a normal color in the horizontal position the rate of sodium disappearance was frequently within normal ranges. If the extremity was elevated at an angle of 35 degrees the rate of the removal of sodium was greatly retarded. With the extremity in this position the administration of drugs which cause a decrease

in blood pressure or generalized vasodilatation resulted in a decrease in rate of mobilization of the sodium.

ODK (Fig 4) a 40 year old male physician first noticed an insidious fatigability of the lower extremities 5 years previous to this examination. Three years ago following 2 days of strenuous hiking and walking there was a precipitous increase in the fatigability. Since that time there has been progressive atrophy of the extremities characterized by feeling of tiredness, aching and claudication. Occasional numbness of the great toes was noted.

Examination revealed no abnormal color changes in either lower extremity, both became ruborous on dependency following elevation but no pallor as present on elevation. There was slight trophic change in the skin and nail of the lower extremities. All arterial pulsation were absent in the extremities.

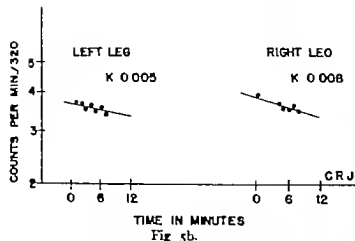


Fig 5. Patient C.R.J. with arteriosclerosis, popliteal aneurysm and gangrene. a, Graph showing skin temperatures b, graph representing rate of removal of sodium, c, arteriogram showing obstruction of femoropopliteal junction

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Oscillometric examination revealed pulsations to be absent distal from the knee inferiorly on the right, increased in the left knee region over the aneurysm and diminished at the left ankle. Skin surface temperatures were elevated on the left and normal on the right. An arteriogram (Fig 5c) was made revealing an obstruction of the femoropopliteal junction.

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Fig 5c

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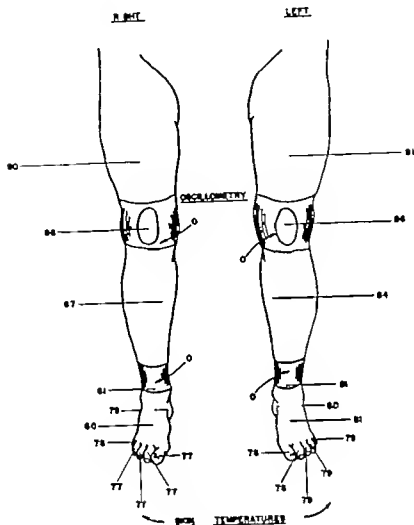


Fig. 6a

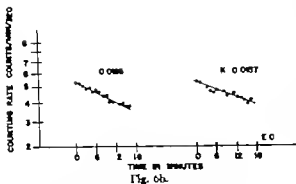


Fig. 6. Patient F H with rteriosclerosis obliterans  
a, Graph showing skin temperatures, b, graph representing  
rate of removal of sodium.

edema was confined largely to the subcutaneous tissues (Fig 7)

*Thromboangitis obliterans (Buerger's disease)* Five patients with thromboangitis obliterans were studied. There was a variation in the degree and extent of the obliterative process in these individuals. In patients with symptoms confined largely to distal ulcerations on the toes and with good major arterial pulsations the sodium disappeared rapidly from the gastrocnemius muscle. Patients with advanced disease demonstrated a slow removal of sodium chloride.

B J F (Fig 8) One year prior to admission, this 53 year old white male developed intermittent claudications in the legs, which gradually increased in

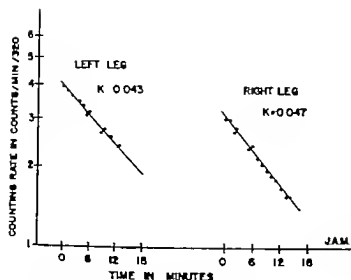


Fig 7 Graph representing rate of removal of sodium in patient with chronic thrombophlebitis

severity. Five months later this was followed by lesions of migratory phlebitis on the left forearm and the lower extremities. Six weeks prior to admission he developed pain and discoloration in the right toe and a small ulcer formed just beneath the great toenail.

Examination revealed cyanosis of the right great toe with a small painful ulcer on the terminal phalanx. Areas of migratory phlebitis were present on the left lower extremity and on the left forearm. Pallor of the right foot developed on elevation. Skin surface temperatures were normal. Oscillometry revealed essentially normal pulsations in the knee and ankle region. The dorsalis pedis pulsation were faint bilaterally. The posterior tibial pulsation was moderate on the left and absent on the right. There was a loss of hair over the toes on the right foot. A diagnosis of thromboangiitis obliterans was made.

A right lumbar sympathectomy was performed with removal of the sympathetic chain from the first to the third lumbar vertebra. There was immediate relief of pain in the foot and improvement in the appearance of the ulcer.

#### DISCUSSION

To obtain constant results by this method of studying the mobilization of radioactive sodium chloride in the muscle certain precautions must be carefully observed. The temperature and humidity in which the patient is studied should be constantly controlled. The procedure should be explained to the patient and his fears allayed regarding the discomfort associated with the procedure and the absence of danger from the use of radioactive materials. At the beginning of the study extremities should be elevated for at

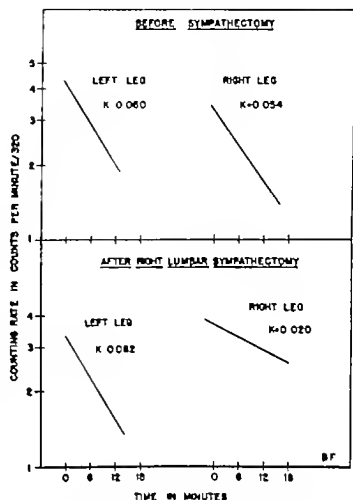


Fig 8 Graph representing rate of removal of sodium in patient B J F with thromboangiitis obliterans, before and after right lumbar sympathectomy

least 10 minutes prior to the injection. The added strain imposed upon the circulation by the position of the extremity will thus become more completely manifest.

The extremity must be carefully placed over the Ciger Mueller tube and the position of the patient must be such that there will be no shifting of the body during the examination. It is obvious that variations in the distance of the injected deposit of sodium into the muscle from the Ciger Mueller tube will in itself change the rate of count and will therefore produce artifacts in the determination. The patient must be constantly observed and reminded that the extremities should remain motionless; this is particularly important in elderly patients who unconsciously change the position of their legs. In individuals whose extremities become painful in the elevated position these determinations must be carried out with the extremities horizontal.

More accurate determinations are obtained if small amounts of fluid are injected. It is necessary that the solution of sodium chloride be carefully prepared and be neutral in reaction.

#### SUMMARY AND CONCLUSIONS

By measuring the rate of disappearance of radioactive sodium chloride from the muscles of an extremity, an additional method of evaluating the circulatory physiology of the extremities has been made possible.

In the study of 57 normal individuals and 102 patients with peripheral vascular disturbances, curves representing the rate of disap-

pearance of the sodium from the muscle form statistically accurate patterns.

It is believed that this method of study may offer a valuable aid in the evaluation of certain forms of therapy which are believed to enhance the circulation.

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# SUTURE OF PERIPHERAL NERVES

## Factors Affecting Prognosis

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Memphis, Tennessee, and JOSEPH BERKSON, M.D., Rochester, Minnesota

ALL who have cared for patients in whose case a peripheral nerve has required suture know that complete recovery of function of the involved nerve does not always occur. Yet it also is known that under the proper circumstances an extremely gratifying recovery can ensue.

Careful selection of cases for neurorrhaphy, accurate operative technique, and good attention to the postoperative care of the patient all tend to produce conditions favorable for recovery. It would seem also that an understanding of the factors of importance in the prognosis of such injuries would lead to better treatment and thus ultimately to more nearly complete return of function than would otherwise be possible.

Because of this, we are recording an analysis of these factors obtained from a group of patients with peripheral nerve injuries during World War II. The literature in recent years has contained numerous reports on peripheral nerve injuries but it is felt that no useful purpose will be served by complete review of these. Instead, we are merely recording experience in one hospital in the hope that the data obtained from such a group of cases may be of value to others.

### MATERIAL

Patients with peripheral nerve injuries, admitted to this army installation from September 14, 1942 to October 1, 1945 form the basis of this study. This group comprised 2,849 patients who had 3,276 injuries to peripheral nerves. For these nerve injuries, 957 neurorrhaphies were carried out of which 673 were done by the members of the neurosurgical service at this hospital. The remainder were done at other army installations prior to ad-

mission of the patients to our hospital and the postoperative course was followed by us. Two hundred and seventy-nine neurolyses and 115 explorations without suture or neurolysis comprise the other operative procedures performed during this period at our installation.

The 957 neurorrhaphies were not all available for careful analysis and inclusion in this series. Cases were excluded if the neurorrhaphy was only partial if we had no definite record or knowledge of the function present in the muscles innervated by the nerve in question prior to neurorrhaphy and if the follow-up period was less than 6 months. After these cases were discarded, 755 neurorrhaphies remained for careful analysis and comprise the material analyzed for this study (Table I).

In each case, a record of the operative procedures and of the preoperative function present was available. Each patient was examined in so far as possible every 3 months during the follow-up period. The majority of patients were followed for 15 months although some were followed for as long as 28 months. Because the majority of patients were under observation for about 15 months, the graphic presentation of the data includes the recovery occurring in the first 15 months after suture. Yet certain definite impressions of the recovery after 15 months were obtained and these will be recorded in the discussion as impressions.

In testing these patients for recovery of motor power, accurate palpation was employed to determine the extent of contraction of the muscle or of movement of its tendon. Due regard was paid to trick movements, substitution, anomalous innervation and the like. Motor power was graded arbitrarily in the following manner: grade 1 consists of a palpable degree of contraction or movement of sufficient strength to produce movement of the part against gravity; grade 2, of a contrac-

From the Section on Biometry and Medical Statistics, Mayo Clinic.

Work done on the Neurosurgical Service, O'Reilly General Hospital, Springfield, Missouri.



months after suture) From this group one is able to determine by examination the number who have recovered function during this latter period and thus the specific recovery rate for the interval can be calculated. The application of such rates calculated for each interval in an appropriate manner gives the desired accumulated recovery rate.

The essentials of the method are basically very simple. As an example they will be presented here briefly in terms of the experience with radial neurorrhaphy analyzed according to the interval between wounding and suture. For purposes of illustration the calculations necessary for construction of the curve for those cases sutured from 4 to 6 months after injury when recovery of the extensor carpi radialis longus muscle only is considered are presented.

These calculations are given in Table II. Fifty-one individuals were examined 6 months after suture who were known not to have recovered at 3 months after suture of these 20 were found to have recovered. The recovery rate for the interval 3 to 6 months therefore was 39.2 per cent. Twenty-seven individuals were examined 9 months after suture who had not recovered at the 6 months point<sup>1</sup> and of these 14 had recovered this gives a rate of 51.8 per cent for the interval 6 to 9 months. Similarly the interval recovery rates for the 9 to 12 and 12 to 15 month periods were found to be 10 per cent and 80 per cent respectively.

With the interval recovery rates so ascertained we proceeded with the calculation as shown in columns 4 to 7 of Table II. We begin with a hypothetical 1,000 individuals who had not recovered at the end of the zero to 3 month period. Of these 39.2 per cent recovered during the interval of 3 to 6 months (column 5) obtained from column 3 or 39.2 have recovered in the interval (column 6) leaving 608 (column 4) who had not recovered at the beginning of the 6 to 9 month interval so that 39.2 per cent (column 7) have recovered by the beginning of that interval. Of the 608 individuals who had not recovered at the beginning of the 6 to 9 month interval 51.8 per cent

TABLE II — EXAMPLE OF CALCULATION OF TIME RECOVERY CURVE FOR RADIAL NEURORRHAPHY PERFORMED 4 TO 6 MONTHS AFTER INJURY. RESULTS OBTAINED IN EXTENSOR CARPI RADIALIS LONGUS MUSCLE

From observations			Calculation of curve			
Interval since suture of nerve, mo	Patients examined with no recovery at beginning of interval	Recovered in interval N Per cent	Patients without function at beginning of interval	Interval recovery rate, per cent	Patients recovered in interval	Per cent recovered by beginning of interval
3-6	61	20 30	1,000	39	392	
6-9	7	14 18	608	51.8	315	30
9-12			293	1	30	70.7
12-15	3	4 80	254	80	1	73.6
15+			21			94.7

recovered during the interval that is 315 leaving 293 (column 4) who had not recovered at the beginning of the 9 to 12 month interval therefore 70.7 or 70.7 per cent (column 7) have recovered by then. The continuation of this process completes Table II. In this manner are determined the percentage of persons recovered at various periods after suture as given in column 7. The course of recovery then can be shown graphically by plotting the accumulative percentage of persons recovered (column 7) against time (Fig. 1).

The construction of each curve of recovery necessitated such a calculation and table. In order to conserve space however none of the other tables are included in this paper.

An attempt was made when studying a given factor such as the wrapping of the suture line with tantalum foil to utilize a homogeneous group of cases. Thus when using the cases of radial neurorrhaphy to study this factor individuals were selected whose nerves were sutured within 9 months after injury and whose lesions were located from 0 to 12 centimeters proximal to the lateral epicondyle. This group was then divided into those in which the nerves had been wrapped in tantalum foil and those in which they had not been wrapped in tantalum foil. The legend for each graph will indicate the method of selection of cases.

In the remainder of the paper the data are presented in their entirety in the graphs. No

<sup>1</sup>Note that this is the number of patients examined 9 months after suture who had not recovered 6 months after suture, not the total number of patients examined 9 months after operation.





months after suture) From this group one is able to determine by examination the number who have recovered function during this latter period and thus the specific recovery rate for the interval can be calculated. The application of such rates calculated for each interval in an appropriate manner gives the desired accumulated recovery rate.

The essentials of the method are basically very simple. As an example they will be presented here briefly in terms of the experience with radial neurorrhaphy analyzed according to the interval between wounding and suture. For purposes of illustration the calculations necessary for construction of the curve for those cases sutured from 4 to 6 months after injury when recovery of the extensor carpi radialis longus muscle only is considered, are presented.

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TABLE II — EXAMPLE OF CALCULATION OF TIME RECOVERY CURVE FOR RADIAL NEURORRHAPHY PERFORMED 4 TO 6 MONTHS AFTER INJURY RESULTS OBTAINED IN EXTENSOR CARPI RADIALIS LONGUS MUSCLE

From observations			Calculation of curve				
Interval since suture of nerve, mo.	Patients examined with no recovery at beginning of interval	Recovered in interval		Patients without function at beginning of interval	Interval recovery rate, per cent	Patients recovered in interval	Per cent recovered by beginning of interval
		N	Per cent				
0-3	5	20	30.	1,000	30.8	309	0
3-6	7	14	51.8	608	51.8	315	39
6-9	10	1	10	903	1	89	70.7
9-12	5	4	80	264	80.0	81	72.6
12-15				51			84.7

recovered during the interval that is, 315, leaving 293 (column 4) who had not recovered at the beginning of the 9 to 12 month interval, therefore 70.7 or 70.7 per cent (column 7) have recovered by then. The continuation of this process completes Table II. In this manner are determined the percentage of persons recovered at various periods after suture as given in column 7. The course of recovery then can be shown graphically by plotting the accumulative percentage of persons recovered (column 7) against time (Fig. 1).

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In the remainder of the paper the data are presented in their entirety in the graphs. No

<sup>1</sup> Note that this is the number of patients examined 9 months after suture who had not recovered 6 months after suture, not the total number of patients examined 9 months after operation.



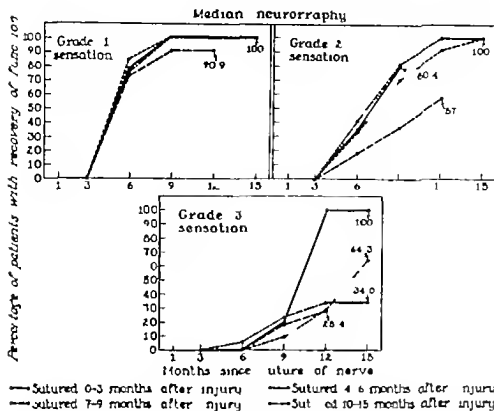


Fig. 3. Effect of the interval between wounding and suturing on the recovery of sensory function after median neurotaphy. Only cases in which the lesion was located 5 centimeters or more distal to the medial epicondyle were included.

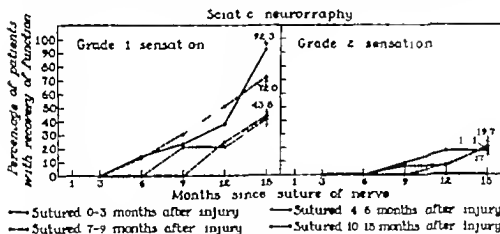


Fig. 4. Effect of the interval between wounding and suturing on the recovery of sensory function after sciatic neurotaphy. All cases. There were no instances of recovery of sensory function of grade 3.

When the divided nerve is sutured 10 to 15 months after injury the results are distinctly inferior. Nonetheless, since 20 per cent of the patients were able to regain active extension of the wrist even when 10 to 15 months had elapsed between injury and suture of the radial nerve suture is worth while in this situation even at that late date. However, when it is done as late as 10 months after severance of the nerve, it must be realized that a certain

portion of the motor deficit most probably will have to be compensated for later by an appropriate transference of tendons.

**Sensory function.** In the median nerve (Fig. 3) and also in the ulnar nerve although the data are not presented, a sensory return of grade 1 can nearly always be expected if the nerve is sutured within 9 months after injury. As a matter of fact 90 per cent of the patients obtained this much return of function when

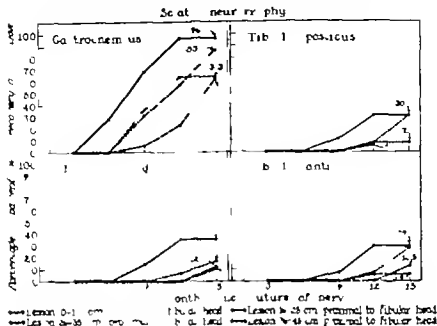


Fig. 5. Effect of the level of the lesion on the recovery of function after sciatic neurotomy. Only cases in which the nerve was sutured within 3 months after injury are included.

the nerve was sutured as late as 15 months after injury. Sensory return of grade 2 like wise ensued in nearly all instances when the nerve was sutured within 9 months of its severance. In more than half of the cases in which the nerve was sutured from 10 to 15 months after injury such a return occurred. There is no doubt, however, that suture within 3 months of injury is of unquestioned superiority in obtaining a return of sensory function to grade 3 in the median and ulnar nerves. Yet the return of nearly normal sensation with stereognosis and two point discrimination is uncommon even under these favorable circumstances.

In the sciatic nerve (Fig. 4) return of sensory function in general was disappointing in our experience. There were no instances of sensory return of grade 3. Suture within 3 months gave slightly less than 20 per cent of the patients so treated return of sensory function to grade 2 which is indeed disappointing. Suture at any time within 9 months gave just about this same result. The postponement of suturing beyond this date gave uniformly unsatisfactory results. It might further be added that the long term follow-up in some cases for 28 months after suture of the nerve has sub-

stantiated these observations that a return of sensory function to grade 3 in the sciatic nerve, even under the best of circumstances, is indeed rare.

#### EFFECT OF THE LEVEL OF THE INJURY

**Motor function.** The data for the sciatic nerve are presented in Figure 5. The conclusions drawn from these data were substantiated by data calculated for the other nerves, which we are not presenting.

It is obvious that in general a higher percentage of patients with distally placed lesions, than of those with more proximally located injuries recover. However even lesions high in the sciatic nerve did allow some motor recovery in many instances. The same is true of lesions high in the nerves of the arm, that is lesions of the brachial plexus and cervical nerve roots.

Thus, in patients with high-lying lesions, a special effort should be made to obtain end-to-end anastomosis within a few months after injury so that the best possible recovery under the circumstances will ensue.

**Sensory function.** The data with regard to sensory recovery are obtained from a comparison of two groups of median nerve in-

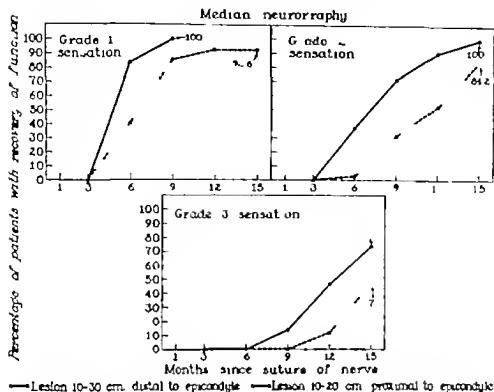


Fig 6 Effect of the level of the lesion on the recovery of sensory function after median neurorrhaphy. Only cases in which the nerve was sutured within 6 months after injury were included.

juries both sutured within 6 months after injury (Fig 6). One group comprises patients with lesions at certain levels in the forearm while the other comprises those with lesions at certain levels in the arm.

Return of sensory function of grade 1 and grade 2 was slightly superior for the low-lying lesions to that for high lying lesions. It would appear also that the low lying lesions have a superior return of sensory function to grade 3. However, since both curves were continuing to rise at the last period plotted, these data are not entirely convincing. The patients whom we have seen as long as 28 months after injury however have given us the impression that this is a true difference.

Mention has been made of the poor prognosis for return of sensory function in cases of injury to the sciatic nerve. Thus the prognosis is unusually poor for recovery of sensory appreciation in high lying lesions of this nerve.

#### EFFECT OF GAP BETWEEN NERVE ENDS AFTER RESECTION OF NEUROMA AND GLIOMA

These data are presented only with regard to return of motor function. Two groups of cases, namely those in which median neuror-

raphies (Fig 7) and sciatic neurorrhaphies (Fig 8) were performed will be considered. Without belaboring the differences that do occur it can certainly be stated without hesitation that the presence of a large gap between the nerve ends is no barrier to at least partial recovery of function if careful suturing has been carried out. Thus we feel strongly that large gaps should never deter the surgeon from carrying out an end-to-end anastomosis if such is at all feasible. In such cases he will frequently be rewarded by a gratifying recovery of motor function.

#### EFFECT OF THE WRAPPING OF THE SUTURE LINE WITH TANTALUM FOIL

**Motor function.** A difference of opinion occurred among the surgeons caring for these patients concerning the value of the wrapping of the suture line with tantalum foil. Consequently two fairly comparable groups of cases are available in one of which wrapping of the suture line was employed and in the other of which it was not employed. The data obtained from an analysis of radial neurorrhaphies are given in Figure 9 and those from an analysis of sciatic neurorrhaphies in Figure 10.



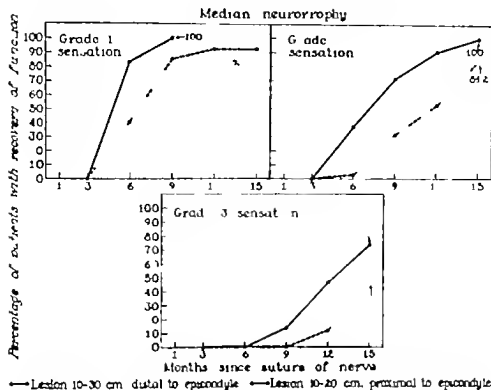


Fig. 6 Effect of the level of the lesion on the recovery of sensory function after median neurotaphy. Only cases in which the nerve was sutured within 6 months after injury were included.

juries, both sutured within 6 months after injury (Fig. 6). One group comprises patients with lesions at certain levels in the forearm while the other comprises those with lesions at certain levels in the arm.

Return of sensory function of grade 1 and grade 2 was slightly superior for the low lying lesions to that for high lying lesions. It would appear also that the low lying lesions have a superior return of sensory function to grade 3. However, since both curves were continuing to rise at the last period plotted, these data are not entirely convincing. The patients whom we have seen as long as 28 months after injury, however, have given us the impression that this is a true difference.

Mention has been made of the poor prognosis for return of sensory function in cases of injury to the sciatic nerve. Thus the prognosis is unusually poor for recovery of sensory appreciation in high lying lesions of this nerve.

#### EFFECT OF GAP BETWEEN NERVE ENDS AFTER RESECTION OF NEUROMA AND OLIOOMA

These data are presented only with regard to return of motor function. Two groups of cases, namely those in which median neuro-

raphies (Fig. 7) and sciatic neurotaphies (Fig. 8) were performed will be considered. Without belaboring the differences that do occur, it can certainly be stated without hesitation that the presence of a large gap between the nerve ends is no barrier to *at least* partial recovery of function, if careful suturing has been carried out. Thus we feel strongly that large gaps should never deter the surgeon from carrying out an end-to-end anastomosis if such is at all feasible, for in such cases he will frequently be rewarded by a gratifying recovery of motor function.

#### EFFECT OF THE WRAPPING OF THE SUTURE LINE WITH TANTALUM FOIL

**Motor function.** A difference of opinion occurred among the surgeons caring for these patients concerning the value of the wrapping of the suture line with tantalum foil. Consequently two fairly comparable groups of cases are available, in one of which wrapping of the suture line was employed and in the other of which it was not employed. The data obtained from an analysis of radial neurotaphies are given in Figure 9 and those from an analysis of sciatic neurotaphies in Figure 10.



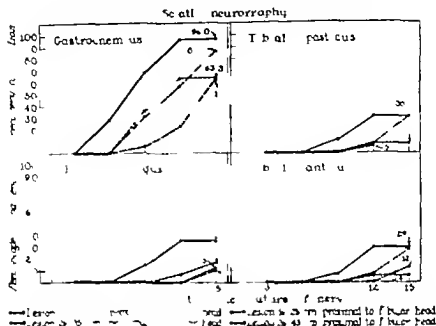


Fig. 4. Effect of the level of the lesion on the recovery of function after sciatic neurotomy. Only cases in which the nerve was sutured within 3 months after injury are included.

the nerve was sutured as late as 15 months after injury. Sensory return of grade 2 likewise ensued in nearly all instances when the nerve was sutured within 9 months of its severance. In more than half of the cases in which the nerve was sutured from 10 to 15 months after injury such a return occurred. There is no doubt, however, that suture within 3 months of injury is of unquestioned superiority in obtaining a return of sensory function to grade 3 in the median and ulnar nerves. Yet the return of nearly normal sensation with stereognosis and two point discrimination is uncommon even under these favorable circumstances.

In the sciatic nerve (Fig. 4) return of sensory function in general was disappointing in our experience. There were no instances of sensory return of grade 3. Suture within 3 months gave slightly less than 20 per cent of the patients so treated return of sensory function to grade 2 which is indeed disappointing. Suture at any time within 9 months gave just about this same result. The postponement of suturing beyond this date gave uniformly unsatisfactory results. It might further be added that the long term follow up in some cases for 28 months after suture of the nerve has sub-

stantiated these observations that a return of sensory function to grade 3 in the sciatic nerve, even under the best of circumstances, is indeed rare.

#### EFFECT OF THE LEVEL OF THE INJURY

**Motor function.** The data for the sciatic nerve are presented in Figure 5. The conclusions drawn from these data were substantiated by data calculated for the other nerves, which we are not presenting.

It is obvious that in general a higher percentage of patients with distally placed lesions than of those with more proximally located injuries recover. However even lesions high in the sciatic nerve did allow some motor recovery in many instances. The same is true of lesions high in the nerves of the arm that is lesions of the brachial plexus and cervical nerve roots.

Thus in patients with high lying lesions, a special effort should be made to obtain end-to-end anastomosis within a few months after injury so that the best possible recovery under the circumstances will ensue.

**Sensory function.** The data with regard to sensory recovery are obtained from a comparison of two groups of median nerve in-

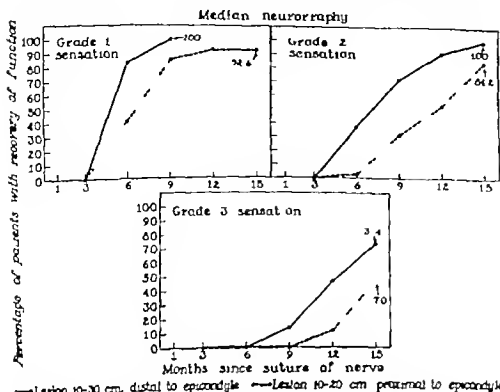


Fig. 6. Effect of the level of the lesion on the recovery of sensory function after median neurotaphy. Only cases in which the nerve was sutured within 6 months after injury were included.

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raphies (Fig. 7) and sciatic neurotaphies (Fig. 8) were performed will be considered. Without belaboring the differences that do occur, it can certainly be stated without hesitation that the presence of a large gap between the nerve ends is no barrier to at least partial recovery of function if careful suturing has been carried out. Thus we feel strongly that large gaps should never deter the surgeon from carrying out an end-to-end anastomosis if such is at all feasible for in such cases he will frequently be rewarded by a gratifying recovery of motor function.

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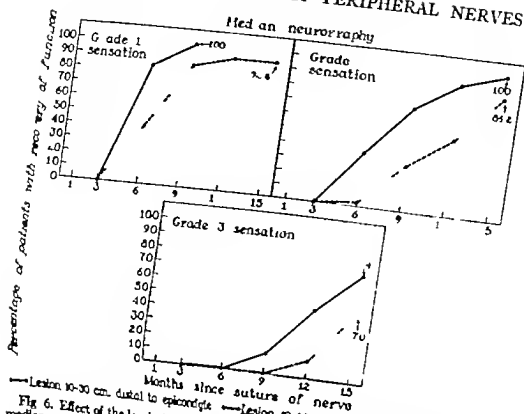


Fig. 6. Effect of the level of the lesion on the recovery of sensory function after median neurotomy. Only cases in which the nerve was sutured within 6 months after injury were included.

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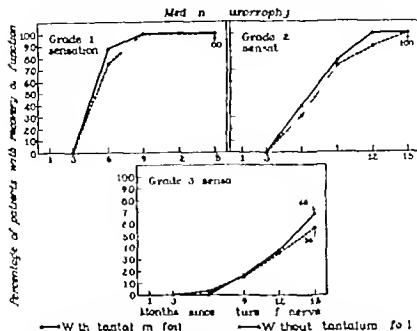


Fig. 1. Effect of the wrapping of the line of suture with tantalum foil on the recovery of sensory function after median neurectomy. Only cases in which the lesion was located from 5 to 30 centimeters distal to the medial epicondyle and in which the nerve was sutured within 9 months after injury were included.

sensory function. These data suggest no great difference in recovery between the cases in which wrapping had been employed and those in which it had not been employed. There would appear to be a slight superiority of return to sensory function of grade 3 in the median nerve when wrapping is employed but it is doubtful if this is of significance.

**Comment.** It can thus be concluded that wrapping of the suture line with tantalum foil has no discernible advantages. In addition to the absence of any demonstrable effect on end results, the use of tantalum foil in this manner seems of doubtful value on the basis of the appearance of the suture line in the nerve at re-exploration. Many surgeons have commented on the fact that such anastomoses in nerves of ten appear attenuated and compressed by a constricting cuff of tantalum foil.

#### EFFECT OF THE MICROSCOPIC APPEARANCE OF THE RESECTED ENDS OF THE NERVES

It was the practice at this neurosurgical center to examine microscopically the cut ends of segments removed from the nerves prior to anastomosis. In this manner examination of

the mirror image of the approximated nerve ends was made. The presence of any neuroma in the proximal end of the nerve or of any glioma in the distal end was ascertained. Further note was made of the presence of shrinkage of the tubules of Schwann's cells, of edema of the funiculi and of fibrosis and cellular infiltration of the nerve trunks.

Because it was also our practice to obtain frozen sections at the time of operation on all questionable nerve ends, we fortunately had a very small number 24 in this series of cases in which operation was performed in this installation and in which the permanent sections showed 'unsatisfactory' nerve ends. In 17 cases a neuroma occupied half or slightly more of the proximal end of the nerve. In 7 cases glioma occupied half or more of the distal end. In 1 of these 7 cases the glioma occupied almost all of the end of the nerve.

A statistical analysis of such a small group is of course impossible. A study of the recovery in these cases does allow a few statements however. In the cases in which half or slightly more of the end of the nerve consisted of neuroma a definite return of function oc-

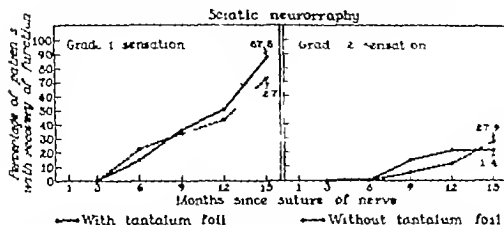


Fig. 12. Effect of the wrapping of the suture line with tantalum foil on the recovery of sensory function after sciatic neurorrhaphy. Only cases in which the lesion was located from 0 to 25 centimeters proximal to the head of the fibula and in which the nerve was sutured within 6 months after injury were included. There were no instances of recovery of sensory function of grade 3.

curred, but in only 3 did a really good recovery occur. Thus it may be fairly concluded that in cases such as this some, although incomplete, return of function may be expected. In only 1 of the 6 cases in which half of the end of the nerve was glioma could the recovery of function be classified as of good quality. In the 1 case in which the distal end was nearly all glioma no return of function occurred.

We thus feel that it is essential to obtain good funiculi both proximally and distally even if this entails the production of a considerable gap between the ends of the nerve. Such a gap of course usually can be overcome by careful and extensive mobilization of the nerve. If it becomes apparent that despite these measures sufficient nerve cannot be resected to give two healthy ends an occasion which should be unusual then the distal end should be resected until good funiculi are seen, the proximal end then should be resected back as far as possible. When on such occasions good funiculi cannot be obtained on the proximal end of the nerve some recovery, although usually incomplete, can be expected.

#### EFFECT OF OTHER FACTORS

**Tension on completed anastomosis.** We were not able to obtain statistical data on this factor. Nonetheless it is our distinct impression gained during the experience of operating on and caring for these patients and substantiated by a careful review of all of their records that some tension on the suture line does not

endanger the functional result. As a matter of fact we have frequently seen cases in which the suture line was under much tension and yet a good recovery of function ensued.

It is obvious that extreme tension on a suture line is not desirable primarily because it imposes the risk of disruption. In certain instances in which considerable nerve is either lost or damaged however it is impossible despite all efforts to effect neurorrhaphy without such tension. If the mobilization has been extensive if sutures are accurately placed in the tough epineurium and if the postoperative immobilization has been properly done disruption of the anastomosis even when under considerable tension is rare. We are of the opinion that it is preferable to resect the nerve back to good nerve ends and to have the anastomosis under considerable tension than it is to resect less nerve in order to have the anastomosis only under slight tension but then to have neuroma or glioma in the sutured nerve ends.

Whenever possible of course the operation should consist of resection of the nerve back to good ends, and the establishment of an accurate anastomosis under only slight tension.

**Suture material.** It was not possible to analyze the data in such a way that the influence of one or another type of suture material could be ascertained. However we wish to record a few impressions.

It is highly probable that any fine nonabsorbable suture material such as silk cotton

tantalum wire or steel wire will yield excellent results. It is important however to use at least a few radiopaque sutures in some manner on the ends of the nerve so that a subsequent roentgenogram will yield information concerning the presence or absence of disruption of the suture line. The importance of a careful check of this in each case cannot be overemphasized.

It did not seem possible to ascertain from our data the effect of the use of a stay suture. On theoretic grounds, however, we believe such a suture is not advisable and we have rarely employed it.

#### COMMENT

These data lend factual confirmation to the results of many previous studies, and also the impressions of many who have managed peripheral nerve injuries. Complete recovery of function to a degree comparable to the normal state is indeed rare after nerve suture. Eminently satisfactory recoveries, however, can be obtained in many instances.

The patient's interests are best served by accurate end-to-end anastomosis of the nerve within 3 months after injury and preferably in the first month after injury. High lying injuries such as those of the brachial plexus should be an especial stimulus to early repair. However repair is of value though limited when done as long as 15 months after injury. Beyond this period motor recovery will rarely result but some return of crude sensory function may occur.

Large gaps between the healthy portions of a divided nerve offer a temptation to the surgeon to deem the lesion inoperable, or to per-

form bulb suture with the hope of subsequent resection and suture. Such extensive injuries do undoubtedly influence unfavorably the end-results even if an anastomosis is obtained. Nonetheless, good results can frequently be obtained in these cases if the surgeon is prepared and willing to undertake an extensive dissection of the nerve in order to make union of healthy ends possible. Despite some encouraging results (2) the superiority of the use of autogenous nerve grafts over end-to-end anastomosis of the divided nerve in such situations has not been conclusively demonstrated.

No advantage is served by the wrapping of the line of anastomosis in tantalum foil. A few metallic sutures at appropriate points in the nerve ends are of value in that they allow the surgeon to assure himself that the anastomosis is still intact at any time in the post-operative period.

The surgeon must not be discouraged at any time during operative procedures on peripheral nerves, for it is usually possible to effect a satisfactory neurotomy. At the same time, he should not be overoptimistic during the months which follow since certain factors may preclude a nearly complete recovery in a given instance. He should recognize these factors and be ready to recommend or perform suitable reconstructive procedures at an appropriate time. This broad view makes available to the patient the best that surgery can offer.

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# STRATIFICATION OF BILE IN THE GALL BLADDER AND CHOLELITHIASIS

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THERE is a voluminous literature on the composition of bile in the gall bladder and on the concentration function of that organ which can be found from recent reviews (8). In these reviews it is implied though not stated that the contents of the gall bladder at any one time, can be thought of as homogeneous so that a sample of bile from any part of the bladder would be representative of the whole.

Yet roentgenological evidence from several investigators (2, 3, 4, 5, 6, 9) has long been published, which indicates, to the contrary, that a high degree of inhomogeneity of bile may exist in the human gall bladder in normal subjects as well as in cholecystitis. Roentgenograms show that the bile in lowest part of the bladder often has a markedly greater radio-opacity than that above with one or more sharp lines of demarcation between.

When floating gallstones are present these are often found to lie in this region of apparent separation between two layers. It is necessary to roentgenograph the patient in an upright, rather than in the usual horizontal position to reveal these phenomena (Fig. 9). Bernstein (2) has put forward a theory of the origin of this stratification and suggested its connection with the formation of gallstones. A review on the roentgenological evidence by Bernstein is in course of publication.

However there have been critics (Akerlund) who have maintained that the introduction of iodized oil needed to visualize the layers leads to artefacts which are wholly responsible for the phenomena observed. It is of obvious importance that our concept of the state of the bile in the gall bladder should include 'stratification' if this is physiologically present so that the suggestion of Dr Bernstein it was decided to seek evidence other than roentgenological on the point.

## METHODS

The obvious line of attack was to secure samples of bile from different levels in the gall bladders of animals and if possible from those of patients at cholecystectomy and to examine them to see if differences existed at different levels. Measurements of specific gravity of the samples which can easily be made with only a few drops, offered the best starting point. Measurements of viscosity, indicative mainly of the amount of mucoid material of hydrogen ion concentration and of a color index were later added.

*Technique of obtaining samples* As far as the choice of an animal was concerned it was felt that one in which gallstones occurred naturally would be most suitable. In answer to a request for information the Ontario Agricultural College replied that among the common experimental animals gallstones occurred so infrequently as to be practically nonexistent though among the domestic animals beef cattle had such stones more frequently than other species. It is of interest that in 1 such animal a cholesterol stone was found in the gall bladder during this research.

Preliminary experiments were made upon the gall bladders of cats which became available. These cats had been used in acute experiments in which various convulsive drugs were given. As soon as the animal had been killed the gall bladder was removed from the body and suspended with the fundus hanging down in order that samples might be taken. Five tenths cubic centimeter samples of bile were then drawn off by means of a hypodermic needle, at intervals of 1 centimeter from one another from the neck down to the fundus of the gall bladder. The uniformity of the distance between the levels of the samples was gauged by suspending the bladder beside a ruler and steadying it there. When possible samples were also drawn from the hepatic ducts.

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The results in the cat series given in detail later were by no means conclusive due to the small size of the bladder and the consequent difficulty in obtaining accurately spaced samples of adequate size.

Gall bladders of cattle proved to be more suitable for the purposes of this experiment. In length from neck to fundus they average about 12 centimeters (7 to 19 cm). Because of their large size it is possible to draw off relatively large samples (2 c.c.) accurately spaced without interfering greatly with any stratification which may be present. The gall bladders were obtained at a local abattoir from beef cattle which were to be killed and the meat dressed for sale. A 48 hour period of fasting preceded the death of the beasts which were 2, 3, and 4 year old heifers for the most part with the occasional bull and cow. It was subsequently appeared that sex and parity in no significant way affected the results obtained. The method of killing is worthy of note. The beast was first driven into a small pen just large enough to hold it, the floor of which was a trap door. It was stunned with a blow on the forehead where upon the trap door was opened and the animal dropped or rather rolled to the killing floor 3 feet below. During this drop the animal was completely turned over so that the gall bladder presumably experienced a considerable amount of disturbance. The actual killing was accomplished by severing the aorta and allowing the animal to bleed to death. A certain amount of struggling marked the death of most of the animals. The animals used in the experiment were completely unselected being taken as they came in order to obtain a representative series on essentially normal beasts. From the time the animal was killed until samples were drawn was, on the average about 15 minutes (7 to 25). As soon as the bladder was freed from the body it was suspended beside the ruler fundus down and samples were withdrawn at centimeter intervals. The needle of the syringe was introduced through the wall bevel upward as close to the vertical axis of the bladder as possible.

In addition a small series of cases in humans was investigated. These were all patients with clinical cholecystitis and cholelithiasis. The

method of obtaining samples will be discussed in a separate section.

#### *Technique of measurements made on samples*

The specific gravities were measured by testing whether a drop of the bile floated or sank in solutions of known specific gravity. The known solutions, in this case were mixtures of bromobenzene and xylene the relative proportions of which were varied to give a series of solutions of known specific gravity ranging from 1.000 to 1.080 in steps of .005 that is to say 1.000 1.005 1.010 and so on. By mixing two of these solutions in equal quantities solutions of intermediate specific gravities were obtained (i.e. measurement was made in steps of .0025 in specific gravity).

The viscosity of the samples was measured by a microviscosimeter of the Ostwald type in which the capillary tube and bulb of a white blood cell pipette was used. The measurement consisted of placing a known quantity of bile, 0.5 cubic centimeter in the viscosimeter and, by means of a stop watch measuring the length of time it took to pass through the capillary tube. Results are relative rather than absolute.

In a small series of bladders the color index of the bile was measured as well as the specific gravity. The measurement was made by comparison in a visual comparison colorimeter (Hellige) of the unknown with a standard solution. Two-tenths cubic centimeter of bile was diluted to 10 cubic centimeters and the comparison was made of this solution with the standard which was 1 to 1000 potassium dichromate solution.

The hydrogen ion concentration was also determined by means of a standard electro-metric apparatus.

*Alternative method of investigating stratification.* A gall bladder obtained in the usual way was suspended over a large graduated cylinder. A small bore hypodermic needle was introduced through the lowest part of the bladder and the bile was allowed to drip out through the needle and run slowly down the side of the graduate. When the bladder had been completely emptied, samples were taken at regular intervals with a pipette introduced to different depths. Specific gravity determinations were made after a period of 4 hours, and

TABLE I—RESULTS

Amount of difference in specific gravity	No. of bladders	Percentage
No change (less than .0025)	1	17
.0025	15	1
.0050		5
.0075	1	8
.0100	1	
.0125		
.0250	1	4
.0175	5	8
.0300	4	6
.0225		1
Greater than .0715	0	
Total	65	100

on samples taken each succeeding 24 hours for 1 week

### RESULTS

*Gall bladders of cats* The results obtained in these experiments were suggestive but the series is too small to have any statistical significance. In all 8 cat gall bladders were investigated by the technique previously described. It was possible to draw off at least 4 samples at centimeter intervals for examination.

Figure 1 shows the results of the specific gravity measurements in 1 of these cat gall bladders. Of the 8 bladders 4 showed changes in specific gravity from the neck to the fundus of the bladder larger than could be accounted for by experimental error. Three of these 4 bladders gave evidence of stratification that is to say, abrupt changes of specific gravity as in Figure 1. In the cases in which it was possible to obtain a large enough sample of bile from the hepatic duct to examine it was found to be much less concentrated (specific gravity 1.015 to 1.020) than the bile of the bladder (specific gravity as high as 1.045).

*Gall bladders of cattle* In Table I the results in a series of 65 animals are analyzed according to the difference found in specific gravity between samples drawn from the uppermost and the lowest levels. It will be seen that in 54 of the 65 bladders there was a difference between top and bottom certainly greater

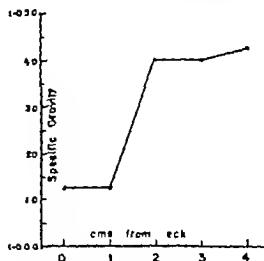


Fig. 1. Specific gravity at different levels in the gall bladder of a cat indicating two "strata."

than the least difference measurable and in a large number of bladders the difference was much greater. From this table it is concluded that a considerable degree of inhomogeneity of the contents of the gall bladder of cattle is the rule rather than the exception.

Table I makes no distinction between those cases in which the change from top to bottom was gradual or at least in steps so small as to be within the error of measurement, and those in which a sudden sharp increase in specific gravity between adjacent samples was found (as in the cat gall bladder of Fig. 1). There were 8 cases in which a sharp increase of .0050 in specific gravity was present, 1 of .0075, and 4 of .0100 as well as 6 more cases in which stratification was probably present. An example in which stratification undoubtedly exists is shown in Figure 2. Moreover there were cases in which there was more than one

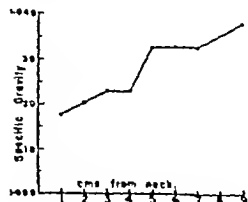


Fig. 2. Stratification in specific gravity in the gall bladder of a heifer.

The results in the cat series, given in detail later, were by no means conclusive due to the small size of the bladder and the consequent difficulty in obtaining accurately spaced samples of adequate size.

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TABLE I—RESULTS

Least of difference specific gravity	No. of bladders	Percentage
No change One inch apart		17
.0075	15	23
.0050	1	8
.0075	3	8
.0050	7	11
.0100		
.0125	3	4
.0150	3	8
.0200	4	6
.0250		3
Greater than .0275		0
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*Gall bladders of cats* The results obtained in these experiments were suggestive but the series is too small to have any statistical significance. In all, 8 cat gall bladders were investigated by the technique previously described. It was possible to draw off at least 4 samples at centimeter intervals for examination.

Figure 1 shows the results of the specific gravity measurements in 1 of these cat gall bladders. Of the 8 bladders, 4 showed changes in specific gravity, from the neck to the fundus of the bladder, larger than could be accounted for by experimental error. Three of these 4 bladders gave evidence of stratification, that is to say abrupt changes of specific gravity as in Figure 1. In the cases in which it was possible to obtain a large enough sample of bile from the hepatic duct to examine it was found to be much less concentrated (specific gravity 1.015-1.020) than the bile of the bladder (specific gravity as high as 1.045).

*Gall bladders of cattle* In Table I the results in a series of 65 animals are analyzed according to the difference found in specific gravity between samples drawn from the uppermost and the lowest levels. It will be seen that in 54 of the 65 bladders there was a difference between top and bottom certainly greater

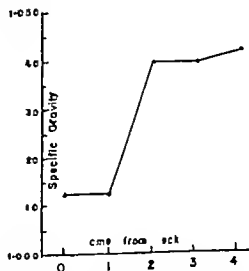


Fig. 1 Specific gravity at different levels in the gall bladder of a cat indicating two "strata."

than the least difference measurable, and in a large number of bladders, the difference was much greater. From this table it is concluded that a considerable degree of inhomogeneity of the contents of the gall bladder of cattle is the rule rather than the exception.

Table I makes no distinction between those cases in which the change from top to bottom was gradual or at least in steps so small as to be within the error of measurement and those in which a sudden sharp increase in specific gravity between adjacent samples was found (as in the cat gall bladder of Fig. 1). There were 8 cases in which a sharp increase of .0050 in specific gravity was present 1 of .0075 and 4 of .0100 as well as 6 more cases in which 'stratification' was probably present. An example in which stratification undoubtedly exists is shown in Figure 2. Moreover there were cases in which there was more than one

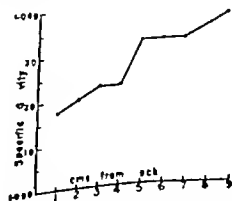


Fig. 2 Stratification in specific gravity in the gall bladder of a heifer



TABLE I.—RESULTS

Amount of difference in specific gravity	No. of bladders	Percentage
No change (less than .001)	11	17
.0015	1	23
.0020	12	18
.0025	5	8
.0030		11
.0035		
.0040	2	
.0045	5	8
.0050	4	6
.0055		3
Greater than .005	0	
Total	61	100

samples taken each succeeding 24 hours for 172 hr.

## RESULTS

**Bladders of cats.** The results obtained in experiments were suggestive but the sample small to have any statistical significance. In all 8 cat gall bladders were investigated by the technique previously described. It was possible to draw off at least 4 small portions in intervals for examination.

The average value of the specific gravities in 10 of these cat gall bladders (in 4 bladders 4 showed changes in specific gravity from the neck to the fundus in which stratification could be accounted for) was .0020. Three of these bladders showed stratification that is, the lower portion of specific gravity as in Figure 1. In one in which it was possible to draw off a sample of bile from the fundus, it was found to be .0025, the same as the (specific gravity) in the neck of the bladder (average .0025).

In the other 5 bladders, the results were as follows: 2 bladders are analyzed in Table I. In 2 bladders, and in specific gravity was .0020. In the remaining 3 bladders, it will be seen that the results were a different. In 2 bladders, the results were greater

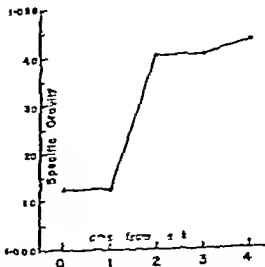


Fig. 1. Specific gravity at different levels in the gall bladder of a cat, indicating two "strata."

than the least difference measurable, and in a large number of bladders, the difference was much greater. From this table it is concluded that a considerable degree of inhomogeneity of the contents of the gall bladder of cattle is the rule rather than the exception.

Table I makes no distinction between those cases in which the change from one portion to another was gradual, or at least in steps so small as to be within the error of measurement, and those in which a sudden sharp increase in specific gravity between adjacent samples was noted (as in the cat gall bladder, Fig. 1). There were 8 cases in which a sharp increase of .0025 in specific gravity was present, .0020 and .0025, .0030 as well as 5 other cases in which "stratification" was probably present. An example in which stratification was probably present exists is shown in Figure 2. If there were more cases in which the results were as in

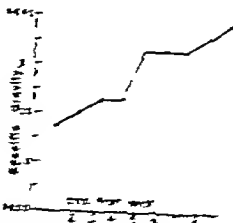


Fig. 2. Stratification of bile in the gall bladder of a cat.



Fig. 3. Results in the gall bladder of a biliary indicating three distinct strata.

sharp increase in specific gravity indicating several strata in the same gall bladder as in Figure 3.

A significant observation was that in all cases in which there was no difference in specific gravity between top and bottom of a gall bladder the specific gravity was throughout very low equal to that usually found in the neck (i.e. less than 1.030).

In the original work of McMaster and Rous (10) on the concentrating ability of the gall bladder the pigment concentration was taken as the criterion of concentration. In view of this, both specific gravity and a color index were measured at different levels in 6 bladders. The results indicated a very close correlation (Fig. 4).

Estimations of the viscosity of the bile were done on 35 bladders. These included 22 immediate samples, 8 twenty-four hour samples, and 5 forty-eight hour samples. Specific gravity determinations were made at the same time. It was found that the viscosity bore little relation to the specific gravity though

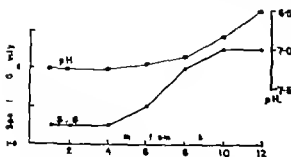


Fig. 5. Relation between specific gravity and hydrogen ion concentration in gall bladder of a biliary.

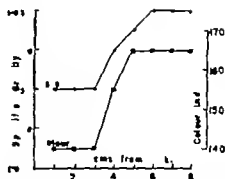


Fig. 4. Relation between specific gravity and intensity of color at different levels in gall bladder of a biliary.

generally speaking the viscosity appeared to increase as the fundus of the bladder is approached. This is more noticeable in the later than in the immediate samples. Viscosities were very variable ranging from 1.4 to 5.0 times that of water with a mean of 2.1 times the viscosity of water.

It was expected that the hydrogen ion would be among the most diffusible of substances and that the hydrogen ion concentration of the bile would be constant throughout the gall bladder even when there was a "stratification" in specific gravity and in concentration of pigments.

Contrary to expectation the results of this investigation show that the pH values in a given bladder are closely correlated with the specific gravity. The bile becomes more acid the greater its concentration. This fact has been long known to apply to representative samples from a gall bladder as concentration proceeds (9) but here it is shown that the relation holds for simultaneous layers in the same gall bladders (Fig. 5). Moreover 24 hour specimens showed no essential change from those which had preceded them. The pH values confirm the finding given by the

TABLE II.—CHANGE IN THE DIFFERENCE OF SPECIFIC GRAVITY TOP TO BOTTOM WITH TIME OF STANDING

No. of bladders	Mean of immediate samples	Standard error of mean	Time of later samples	Mean of later samples	Standard error of mean
10	0.018	± 0.004	14 hrs.	0.025	± 0.004
10	0.010	± 0.003	18 hrs.	0.018	± 0.004
4	0.0073	± 0.004	7 hrs.	0.0080	± 0.003

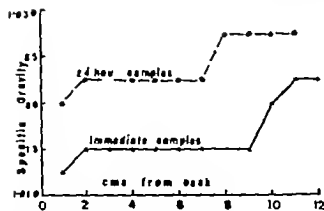


Fig. 6 Shift in specific gravity in a beef gall bladder after hanging 24 hours.

specific gravity samples that the concentration of bile in the gall bladder is far from homogeneous.

In addition to the specific gravity determinations made as soon as possible after death, determinations were made 24 hours later on the same bladders in 10 cases, 48 hours later in 10 other cases, and 72 hours later in 4 cases. The means with their standard errors are given in Table II.

Except for the difference between the 4 hour and immediate samples, where there is a slightly significant change, there is no evidence of diffusion having significantly decreased the inhomogeneity in the contents of these gall bladders. It is to be noted however that though the gradient had not changed in most cases all the specific gravities were higher in the 24 hour samples than in the corresponding immediate samples (Fig. 6). This is probably due to evaporation and possibly to the absorption of water by the wall of the bladders in the period. The character of the stratification remained the same in spite of evaporation and the removal of the samples. In the case in which the contents of a gall bladder were allowed to drip slowly into a tall graduate the gradient was found to persist even after 1 week (Fig. 7).

Diffusion between the strata is certainly remarkably slow so that once present the stratification persists. To determine whether or not diffusion would be equally slow in a similar system with comparable viscosity and specific gravity, an artificial stratification was made of 18 per cent glycerine in water under distilled water. The results are shown in

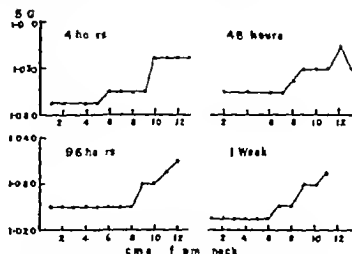


Fig. 7 Persistence of gradient of specific gravity in bile dripped into a graduated cylinder.

Figure 8. The diffusion though slow is definitely faster than in the case of stratified bile, so that in the latter some other physicochemical factor than viscosity and specific gravity must play a part. The strongest evidence that mixing of the strata hardly occurs even with mechanical agitation is that stratification was found in the gall bladders of these cattle though in the process of killing and removal of the gall bladders there had been quite violent changes of position.

**Human gall bladders.** A short series of experiments on human gall bladders obtained at operation is included here. A longer series on human material is being accumulated by one of us and will be presented later elsewhere.

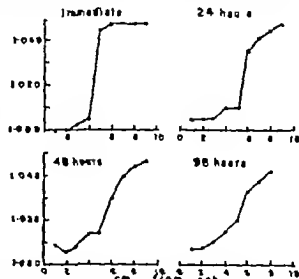


Fig. 8 Change of gradient in specific gravity due to diffusion in a layered sample of distilled water over an 18 per cent glycerine solution.



(Operative procedures were not carried out by the authors.)

In each case an attempt was made to remove samples of bile from the bladder *in situ* that is before it had been disturbed by the manipulations occasioned by its removal. Following removal samples of bile were drawn from the bladder suspended with the fundus down at intervals of 1 centimeter. On these two sets of samples specific gravity and other determinations were made. Of the series of 5 bladders, on 3 both sets of samples were obtained on 1 it was possible to obtain samples only after removal and on 1 bladder samples were obtained only before removal. In 1 case it was possible to obtain complete roentgenological investigation i.e. pictures of the bladder preoperatively as well as postoperatively in both the supine and upright positions.

Figure 9 shows the layer of small floating stones visible when one of the patients was in the erect position. The stones were also visible again floating in a horizontal line when the patient was in the supine position. Roentgenological examination revealed that a good degree of functional contractility and of concentration by the gall bladder was present. Figure 10 shows the results of analysis of samples from this bladder before and after operation. The dotted line represents the level at which the stones floated. There were 19 of these all of specific gravities between 1.040 and 1.045 so that they were evidently floating in bile of their own specific gravity. This case illustrates the existence of marked stratification of bile in a human gall bladder and the fact that floating stones occur near the region in which the specific gravity changes abruptly. Two other cases of the 5 showed marked differences of specific gravity from top to bottom and evidence of stratification. The series of values of specific gravity in samples from top to bottom ran in the 3 cases

1.020 1.020 1.025 1.0375 1.0375 1.0375  
in one case and 1.015 1.015 1.015 1.015  
1.0175 1.0175 1.0275 in the other

In these cases, the stones that were present were not floating but at the bottom. This brief series of human cases serves to show that the phenomena of stratification suggested by

the radiological evidence of Bernstein in normal as well as diseased humans, can be found by other methods in humans as well as in cattle and cats.

#### DISCUSSION OF RESULTS

A series of experiments has been described in which the bile of the gall bladders of cats, cattle and human beings has been investigated for evidence for or against the presence of strata as observed roentgenologically. The results show that the bile of many normal gall bladders is not of a homogeneous composition throughout and that the stratification is remarkably persistent in spite of diffusion. Furthermore the presence of strata has been demonstrated in a sufficiently large number of these bladders to justify the conclusion that stratification occurs as a normal physiological phenomenon in the functioning gall bladder.

The fact of persistent inhomogeneity of the contents of a gall bladder in the normal physiology of these animals, as well as in cholelithiasis, has an important bearing on the interpretation of previous researches. For example, when small samples have been with drawn from gall bladders at successive times to indicate the progress of concentration within the bladder the question must be raised whether such samples were representative of the contents as a whole and so could give reliable information. Some of the reports of astonishingly rapid concentration may have been due to the withdrawal first of more dilute samples from high in the bladder and later of samples of greater concentration from a stratum below.

A simple explanation of the formation of strata of bile in the gall bladder may be suggested. Let us suppose that after filling with dilute hepatic bile the gall bladder has considerably concentrated this before a contraction occurs. Unless this contraction is complete expelling all of the contents, there will be a residue of concentrated bile. Relaxation of the gall bladder will draw in on top of this, a more dilute hepatic bile. If as has been demonstrated the two biles do not readily mix, there will then be two distinct layers of bile in the bladder. A second partial contraction and relaxation might introduce a third



Fig. 9. Roentgenogram of patient with floating gallstones, taken in the erect position.

layer and so on. Thus the presence of stratification would be primarily due to the incompleteness of contraction of a gall bladder which is still able to concentrate.

It has been demonstrated that once established such stratification is remarkably persistent and resists mixing by mechanical agitation. The roentgenological evidence and evidence in humans here reported strongly suggest that the floating gallstones are associated with interfaces between two biles of different concentration. This suggests that the precipitation of cholesterol may be favored at such persistent interfaces by a physicochemical mechanism.

An observation on the population of multiple cholesterol stones in a human case is pertinent which can be explained by the picture

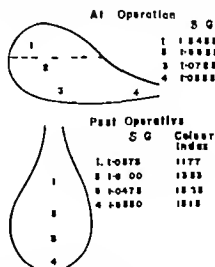


Fig. 10. Results on samples of bile taken from human gall bladder shown in Figure 9.

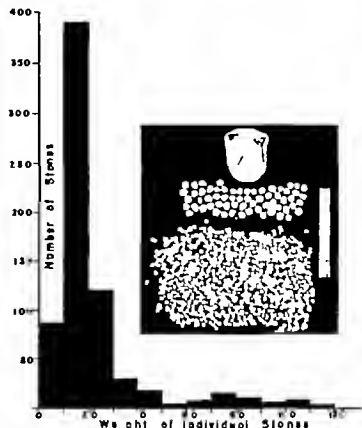


Fig. 1. Population of multiple stones in a human gall bladder showing distinct "families."

of events just described but is difficult on other theories. This gall bladder was full of a very large number of stones of greatly different sizes as well as one large calculus filling the fundus. On inspection the stones could be segregated into what appeared to be three distinct groups (Fig. 11). All were weighed and a statistical population study made. The histogram (Fig. 11) shows that there are as well as the large calculus at least two statistically distinct families of gallstones (corresponding to the maxima in the graph) indicating that there must have been several distinct new beginnings of such families. A new partial contraction and drawing in of a new layer of hepatic bile above the concentrated layers might well be the starting point of each new family of stones.

Theories of cholelithiasis can be grouped under two headings. First there is the metabolic theory in which it is thought that the bile secreted by the liver into the gall bladder is not of normal composition and that this somehow leads to precipitation of calculi. The second theory is that of infection in which

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In each case an attempt was made to remove samples of bile from the bladder *in situ* that is before it had been disturbed by the manipulations occasioned by its removal. Following removal samples of bile were drawn from the bladder suspended with the fundus down at intervals of 1 centimeter. On these two sets of samples, specific gravity and other determinations were made. Of the series of 5 bladders, on 3 both sets of samples were obtained, on 2 it was possible to obtain samples only after removal and on 1 bladder samples were obtained only before removal. In 1 case it was possible to obtain complete roentgenological investigation i.e. pictures of the bladder preoperatively as well as postoperatively in both the supine and upright positions.

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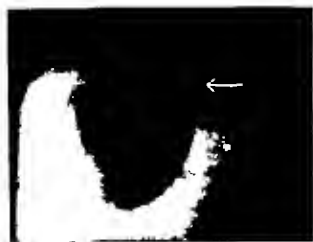


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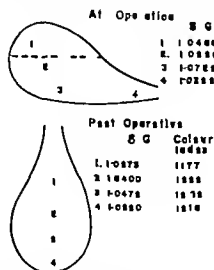


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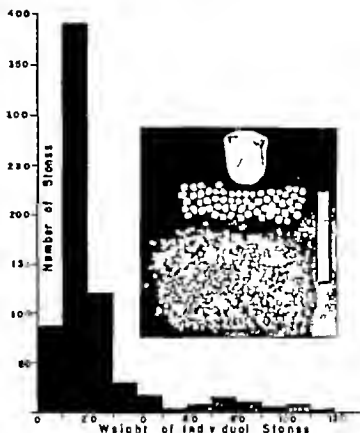


Fig 11. Population of multiple stones in a human gall bladder showing distinct "families."

of events just described but is difficult on other theories. This gall bladder was full of a very large number of stones of greatly different sizes as well as one large calculus filling the fundus. On inspection the stones could be segregated into what appeared to be three distinct groups (Fig 11). All were weighed and a statistical population study made. The histogram (Fig 11) shows that there are, as well as the large calculus, at least two statistically distinct families of gallstones (corresponding to the maxima in the graph) indicating that there must have been several distinct beginnings of such families. A new partial contraction and drawing in of a new layer of hepatic bile above the concentrated layers might well be the starting point of each new family of stones.

Theories of cholelithiasis can be grouped under two headings. First there is the 'metabolic theory' in which it is thought that the bile secreted by the liver into the gall bladder is not of normal composition and that this somehow leads to precipitation of calculus. The second theory is that of infection in which

infection of the gall bladder wall by altering the absorption of different constituents of the bile is thought to bring about the precipitation. The work here reported suggests that a third factor cannot be neglected. Mere inability of the gall bladder to contract completely leading to infrequent or incomplete emptying of the contents, may itself favor the precipitation of cholesterol stones because of persistent stratification of the bile.

#### CONCLUSIONS

It is concluded from these experiments that in cats, cattle and in humans the contents of the gall bladder are far from homogeneous as regards specific gravity, concentration of bile pigments and hydrogen ion concentration, and that this is a physiological rather than a pathological phenomenon. The inhomogeneity is often so abrupt as to suggest that distinct strata of bile of different degrees of concentration coexist. The observations also show that when such stratification exists, it is remarkably persistent and resists the process of diffusion and quite violent mechanical agitation.

The formation of such strata is readily explained in terms of incomplete emptying of a gall bladder which is able to concentrate the bile. The consequences of long persistent stratification have not been demonstrated, but there is suggestive evidence, in cases of floating multiple stones, that it may favor the precipitation of cholesterol stones.

#### SUMMARY

1. Samples of bile withdrawn at different levels in dependent gall bladders of cats, cattle and of some humans have been examined as

to their specific gravity, concentration of pigments, viscosity and hydrogen ion concentration.

2. A lack of homogeneity from top to bottom is the rule rather than the exception. In 65 gall bladders of normal cattle 60 per cent showed an increase in specific gravity from top to bottom of .005 to .023 unit. Changes in hydrogen ion concentration and in color index closely paralleled the changes in specific gravity. Changes in viscosity were not well correlated.

3. The changes were often so abrupt as to show the existence of two or more distinct strata.

4. Neither the process of diffusion for as long as a week nor considerable mechanical agitation was able to mix these strata.

5. In 2 of the 5 human cases, cholesterol stones were floating at the level of the interface between two strata.

6. A theory of the formation of such strata in terms of incomplete emptying of a gall bladder able to concentrate is suggested.

7. The possibility is discussed that persistent stratification of bile may favor the precipitation of cholesterol stones.

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# VASCULAR CHANGES OF THE SKIN IN PREGNANCY

## Vascular Spiders and Palmar Erythema

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Cincinnati Ohio, and JAMES F EMBICK M D, Iowa City Iowa

ALTHOUGH American textbooks on obstetrics do not mention them there are scattered references in medical writings to vascular spiders and palmar erythema as banal complications of pregnancy which tend to clear up following delivery (4 6 7 8 11 12 13 14 15 16 17 18 23 24 29 30 32) The general subject of vascular spiders and palmar erythema has been the theme of extensive reviews and there has been a revived interest in these phenomena recently with many contributions from internists and dermatologists No systematic study of these vascular lesions and their natural history in pregnancy has been made although there are reports of changes in capillaries (20) We therefore undertook a comprehensive investigation of the problem in the clinics and on the wards of the obstetrical service of the Cincinnati General Hospital In addition we have collected from the literature all related reports we have been able to find The significance of these vascular changes in the skin is not known but clinical relationships suggest that there is some connection with endocrine changes These are under investigation It is hoped that more attention will be given these phenomena by specialists in the fields of obstetrics endocrinology and gynecology The purpose of this paper is to report the results of the clinical study and a review of the literature The completed analysis of all possible correlations among the observations made will be reported later

### DESCRIPTION OF THE VASCULAR SPIDER AND PALMAR ERYTHEMA

The vascular spider has been called by many names it has been designated nevus

From the Department of Internal Medicine and the Department of Obstetrics of the College of Medicine, University of Cincinnati and the Cincinnati General Hospital

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angioma, and telangiectasis The type occurring in persons with chronic liver disease has been described in detail elsewhere (6) Three features characterize the usual variety a body legs and surrounding erythema A central point or eminence constitutes the body of the spider and in small or beginning lesions this may be the only abnormality In large ones it may project one or more millimeters above the level of the surrounding skin surface and when of sufficient size its pulsations may be felt Branching legs or radicles come away from the body and decrease in size as the periphery is reached There may be some irregularity of the legs as they dip out of sight and reappear further away from the center The entire area encompassed by the legs is redder than the adjacent skin and in some instances the erythema may occur with few or no visible radicles The skin may reveal other changes consisting chiefly of scattered vascular strands which have a resemblance to the silk threads in American paper money In studying the earliest visible changes in the skin during pregnancy we have seen several instances of a very pale area in the skin later becoming the site of a vascular spider After one or more weeks a red spot of pin head size appears in the center of the pale area and this gives rise to the anemic halo (Fig 1) which has been described (23) and pictured before (12) Not all of these pale spots subsequently develop vascular changes some gradually disappear The temperature over a vascular spider is higher than that of the surrounding skin because of the local increase in arterial blood A fiery red color is characteristic and the lesion does not appear in infra red photographs (5) Blood flows from the body toward the periphery as may be seen in the refilling of a spider following its obliteration by pressure or by gently pressing a glass slide over the area There is a curious predilection for distribution



Fig. 1

Fig. 1. The anemic halo. This is the earliest stage of the vascular spider here pinpoint red spot is found occupying the center of small area paler than adjoining skin.

Fig. 2. Typical large vascular spiders, one of which has been covered with oil to reveal the vessels radiating from the center. In those not covered with oil the erythema surrounding the central punctum is prominent.



Fig. 2.

over the upper parts of the body with the face, neck, upper chest and arms frequently affected. It should be emphasized that as the study progressed with repeated scrutiny and concentration we have detected smaller and smaller lesions. Indeed in certain persons with lightly pigmented skin which had a conspicuous pattern of vascular markings we noted spiders appear at the level of barely perceptible visibility in the pale regions. Thus a single small red spot appeared to be surrounded by an anemic halo. Later the body grew larger legs sprouted outward and grew in a centrifugal direction branching when they reached sufficient size. We have recorded ns

spiders in our data only such lesions as we were able to record by ordinary black and white photography. Various types of lesions are illustrated in Figures 1 to 6.

We have no observations on the microscopic characters of the vascular spider or palmar erythema of pregnancy. Histological details of the spider of chronic hepatic disease have been published elsewhere (6).

Palmar erythema may occur in two distinct forms in women during pregnancy. The first variety is similar to the "liver palms" of chronic hepatic disease. It begins as a diffuse redness most prominent in the proximal part of the hypothenar eminence. Cyanotic spots may appear in the red areas. In more advanced stages the thenar eminence is involved also and a more extensive area of the hypothenar eminence becomes bright red. Next the parts of the palm between the metacarpophalangeal joints develop red spots and the palmar pads of the finger tips become red. Later the base of the nails may be affected. The red areas are sharply separated from adjoining skin of normal color. The other variety consists of a diffuse mottled erythema involving the entire palmar surface with a speckling of pale areas a millimeter or more in diameter. This is an exaggeration of the nor-

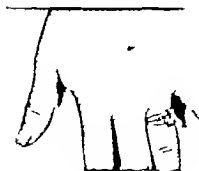


Fig. 3. Characteristic vascular spider on the dorsum of the hand.

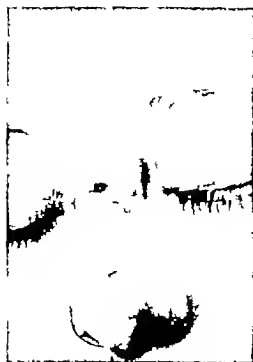


Fig 4.

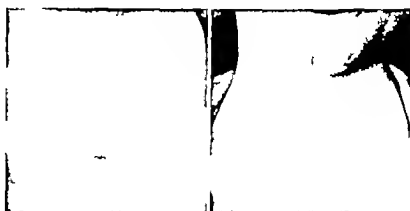


Fig 5

Fig 4. Vascular spider on bridge of nose showing elevation of body above the level of surrounding skin. Pulsation is felt readily in this type of lesion.

Fig 5. Vascular spider appearing below jugular notch during pregnancy and follow up photograph demonstrating that it has disappeared by the seventh week following delivery.

mal mottling of the palm. At times there is a patchy cyanosis of parts of the palm so that there is an irregular display of red, white and blue. There is a tendency for the vascular markings of the palm to show some variation, part of which is spontaneous and part of which may be induced by elevating or depressing the hand. In some instances the type of erythema has changed during the course of observation and the localized type has become the diffuse type or vice versa. There is a trend for redness to increase in intensity as pregnancy runs its course. This may be pronounced early after the first appearance of redness or may be gradual throughout gestation. These vascular changes of the hand have no regular relation to edema of the hands. A number of women studied before palmar erythema became apparent had cold sweating hands and an increase in the vascular markings of the arms with reticulated areas of cyanosis surrounding pale islands of skin similar to the pattern which may become fixed in erythema *ab igne*. The types of palmar erythema are demonstrated in Figures 7 to 9.

#### REVIEW OF THE LITERATURE VASCULAR SPIDERS

In an earlier paper (6) one of us reviewed some of the casual and detailed reports of

vascular spiders in pregnant women and pointed out the curious complete absence of comment on these common vascular changes in American textbooks of obstetrics.

So far as we have been able to determine the first observation of spiders appearing during the course of pregnancy was recorded by Corbett in the *British Journal of Dermatology* in 1914 (11). He merely stated that he had seen spider angiomas appear in the skin during pregnancy and disappear entirely after delivery. The next note on cutaneous spiders in pregnancy was recorded by Zeisler (32). He suggested the possibility of syphilis as a causative agent. Konrad (17) gave a more detailed description in 1925, calling attention to the



Fig 6. Vascular spider on the knee, a very rare location and subsequent picture revealing its disappearance following delivery.



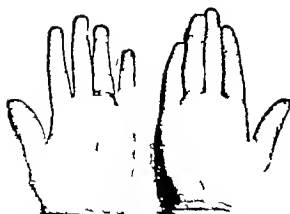


Fig. 7. Palmar erythema. On the left is the variety which is most marked on the hypothenar eminence. In the center of the thenar eminence, the palm between the palm is near the metacarpophalangeal junction and the finger tips. On the right the palm is diffusely involved. The mottled erythema, cyanosis, and pallor which is an exaggeration of the mottled pattern seen in the normal hand.

appearance of telangiectases on the face, neck, and arms during the second month of pregnancy. This was the first emphasis on the distribution over the upper parts of the body characteristic of the acquired cutaneous spider of pregnancy as well as that of hepatic disease. The abrupt fading or disappearance of these marks in the postpartum period was observed. A similar finding was reported in a woman who had a pituitary tumor (1) and the possibility was considered that an endocrine disorder might be responsible for the skin lesion. Two examples of spiders in pregnancy were encountered by Urbach (26) who described them in detail. They vanished shortly after delivery. Gougerot and Meyer (16) suggested a possible familial tendency. They observed the appearance of typical spider-like angiomas during the fifth month of pregnancy in four consecutive gestations, in a woman whose two sisters had also acquired spiders during pregnancy. Because of syphilis in the family they believed the lesions to be stigmas of hereditary syphilis. Distribution on the neck, arms, and hands was noted. There were no mucosal lesions and no tendency to bleeding.

Another report (23) described a case in which spiders were not present during the first and second pregnancies but in the third month of the next pregnancy appeared on the

neck, chest, and arms. The paper included a description of spiders of several varieties and sizes with the larger ones typical in shape, having an elevated central boss and a peripheral anemic halo. The authors believed the distribution was related to the cutaneous nerves derived from the brachial plexus. In a report by Madden on generalized angiomatosis (19) 2 cases of vascular spiders acquired during pregnancy were included. In one, a 30 year old white woman they appeared during the third month, increased in number up to the seventh month and all disappeared about 2 months after the second pregnancy was terminated. Similar smaller lesions had appeared during the first pregnancy. Another patient acquired similar vascular spiders in the fifth month of pregnancy. Mitchell (21) referred to 3 similar cases.

Forman (15) described a case in which the woman acquired spiders early in the second month of 11 consecutive pregnancies, each of which ended with delivery of a stillborn fetus before term. The spiders faded rapidly within a week after labor. He believed that an endocrine disturbance was responsible. In addition the coming and going of cutaneous spiders concurrently with the waxing and waning of symptoms in a patient with peptic ulcer was noted. Vignes, Hanoun and Vial (29) have reviewed some of the European literature on spiders in women during pregnancy and have recorded their familiarity with this lesion. Davis (12) has contributed a learned discussion of subcutaneous hemangioendotheliomas associated with pregnancy in which he discusses the rare malignant variety and includes a number of excellent photographs of typical vascular spiders. He collected a series of 11 such cases during a 2 year period from various antenatal clinics. The description given of a type characterized by a 'pigmented warty growth projecting under the superficial layers of the skin' classifies it as one of the pigmented warts discussed by Brickner (9, 10). The suspected relationship of this type of lesion to the much commoner vascular spider of pregnancy has been discussed (6).

Smith (24) has recorded observations on spider nevi appearing during the last month of the second pregnancy in a 26 year old woman

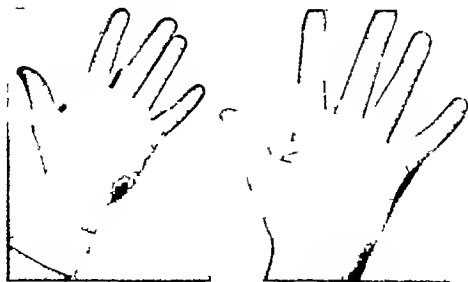


Fig. 8. Photograph of the hand during and after the occurrence of the sharply localized variety of the palmar erythema of pregnancy.

During a third pregnancy they appeared again on the back and upper chest during the fifth month. Some idea of the difficulty of tracking down medical reports of this phenomenon can be seen in the title of Smith's note—The Treatment of Hereditary Telangiectasia.

Walsh and Becker (30) in their monograph on erythema palmare and naevus araneus like telangiectases gave full description of 6 cases in which vascular spiders developed during pregnancy (in 4 palmar erythema was also present). In some of the patients spiders had been present before pregnancy. Their advent occurred anywhere from the third to seventh month of pregnancy. Spiders tended to parallel the palmar erythema in the time of appearance and disappearance, but there were some exceptions. These authors discussed the number, size, configuration and distribution of the vascular spiders. For the first time arterial pulsation was described in the spider of pregnancy. Their investigation included inspection with the capillary microscope and histologic study. A low power view of one of their biopsy specimens gives a clear idea of the two types of vessels encountered: (1) the thick coiled stem artery in the subcutis branching directly into (2) veins of comparable size. This they termed an arteriovenous anastomosis but did not note that it is not a true arteriovenous anastomosis but has a multitude of veins branching from a central artery and these veins distribute blood into

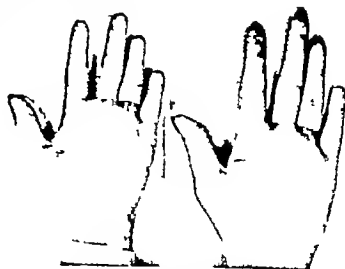


Fig. 9. The hand during and after the occurrence of the diffuse mottled palmar erythema of pregnancy.

a capillary bed before it is conveyed away in true veins. They did not find any evidence of hereditary tendency except in the cases presenting palmar erythema, nor did they see any indication that the spiders had followed minor trauma such as mosquito bites, pinpricks and the like. There was no incrimination of syphilis or hepatic disease. They thought the most probable cause to be some endocrine disturbance. Newman (22) believed the cause was an increase in blood volume plus the effects of the hormone progesterone.

Hean (6) reported observations in 41 women who acquired vascular spiders during pregnancy. In many instances they were observed to appear from the second to the fifth month of

pregnancy. Usually they disappeared at or shortly after the time of delivery. There was no indication that hepatic disease was responsible for the vascular spiders in the women surveyed. Data from pregnant women (27) might support the suggestion that quantitative changes in circulating estrogens are responsible for the appearance of acquired vascular spiders in pregnancy (6) and hepatic diseases.

#### REVIEW OF THE LITERATURE PALMAR ERYTHEMA

It is likely that earlier references to palmar erythema acquired during pregnancy exist but the first notice of it that we have found was that by Feldman in 1939 (13, 14). In a very brief comment he discussed a woman in whom redness of the palms appeared during her second, third, and fourth pregnancies and disappeared when pregnancy was terminated. He speculated about a possible relationship to increased blood volume and the hormone problem. Walsh and Becker (30) have contributed the classic paper in this field and were the first to record the concurrent appearance of vascular spiders and palmar erythema in pregnancy with their subsequent clearing after delivery. Much of the early literature on palmar erythema was reviewed by these authors.

In a brief note (3) one of us suggested that vascular spiders and palmar erythema observed in pregnancy, chronic hepatic disease, and nutritional deficiency disorders might be caused by estrogenic hormones and presented preliminary studies which indicated that such changes in blood vessels of the skin might be induced by administering estrogens to susceptible persons. In the first paper exclusively devoted to the subject of erythema of the palms in pregnancy, Lofgren (18) described in detail 14 cases he had investigated. He presented striking photographs of the return to normal which had occurred by the fourth postpartum month in a woman with the palmar erythema of pregnancy. He made the suggestion independently that estrogenic substances might be responsible for their appearance. To test his hypothesis he administered estradiol benzoate to one of the women 4½ months after delivery. There was definite increase in the palmar red-

ness, but it did not reach the intensity of the erythema present during pregnancy.

A review of the subject of palmar erythema and cutaneous vascular spiders (4) included the suggestion but no further evidence that these changes in the skin were related to high levels of circulating estrogens. No discussion of the problem in pregnancy was included. In an extensive survey of the cutaneous arterial spider (6) it was mentioned that the anatomical substrate of palmar erythema might be related to the arteriovenous glomeruli bodies so profusely distributed in the palmar skin. In addition to hepatic disease and normal pregnancy, palmar erythema is common in pulmonary tuberculosis (2, 25) and it was suggested that clubbing of the fingers may be related to the associated increase in blood flow (4).

These few references are all we have been able to find in searching recent medical writings on the subject. Doubtless there are other reports. One of the main reasons for undertaking this study was the lack of any systematic information on the incidence, course, and probable significance of vascular spiders and palmar erythema which occur during pregnancy.

#### PROCEDURES

The present study was set up to learn what we could of the natural history of the vascular spider and palmar erythema acquired during pregnancy. Thanks to the co-operation of members of the obstetrical service we were permitted to examine each patient seen on every visit to the prenatal clinic, during hospitalization for delivery and again at the postpartum visit 6 weeks after discharge following the 4 to 10 days of hospitalization for delivery. All initial examinations were made by the senior author and subsequent ones were made by various members of the group in addition. Observations were begun in July 1946 but it was not until October 1946 that every woman was examined on each clinic visit. At that time a system of examination and record keeping was put into effect. Because there was neither adequate time nor personnel our inspection was limited to the hands, lower and upper arms, face, neck and upper chest. Con-

ditions of lighting were kept constant. An artificial blue light was used and all patients were examined while standing before the light. A record was kept of the presence or absence of vascular spiders and their location and number if present. Palmar erythema was recorded if present, and whether of the diffuse or sharply localized form. A notation was made of the depth of skin color in both white and negro patients. A very large number of photographs was taken and in some cases a series of them was made throughout pregnancy in the hospital shortly after delivery and again at the final postpartum visit. In patients who had either type of vascular change in the skin an effort was made to ascertain its time of appearance but this information was not very reliable except that some patients were aware of vascular spiders or palmar erythema antedating pregnancy. Others we collected 24 hour specimens of urine for hormone assay but the results are not adequate for detailed analysis. In a few patients liver function studies were done.

Our subjects included all women examined in the prenatal clinic who were in attendance in October 1946 and all new clinic patients who came in through October 23, 1947.

Our discussion where possible deals with the largest number of cases fully studied. In most instances data are derived from all pertinent records but in some of the figures only those with complete records were included. Records were designed so that the information could be transferred to International Business Machine punch cards to facilitate processing. Charts of distribution of vascular spiders were kept to follow individual lesions. Degree and type of palmar erythema were noted.

In order to make extensive correlations with other data concerning the patient and her offspring we obtained information on age, color, parity, on sex, weight, viability, and normality of offspring on complications related to toxemia and eclampsia, on lactation and season of the year. The date of the last menstrual period was recorded in order to learn the time in pregnancy when the skin lesions appeared or the duration of pregnancy at the time of the first visit if lesions were

already manifest. The date of delivery was recorded and in the final analysis the time of appearance of vascular changes was based on recalculation from date of delivery in all pregnancies which went to term. Some of the possible correlations have been made but many await future study.

The total number seen in the clinic was 1,243. There were 484 white and 759 negro women. Records have been fully analyzed on 302 women who were seen during hospitalization and at the routine postpartum visit. An additional 537 were seen during the week after delivery but had not returned for follow up in spite of our special efforts to make a final examination. The remainder were under observation when we began compiling this paper.

#### OBSERVATIONS VASCULAR SPIDERS

Vascular spiders were found in 321 or 66.6 per cent of the 484 white women observed and in 87 or 11.4 per cent of the 759 negro women at some time during pregnancy. Since women presented themselves at varying stages of pregnancy for their first clinic visit our figures on incidence of spiders throughout pregnancy are not derived from large numbers there being relatively few women seen during the second and third months of pregnancy while the totals were very high by the last month. In Figures 10 and 11 we have calculated the percentage of all women seen in any month of pregnancy who had vascular spiders at that time. There were relatively few subjects seen in the early months of pregnancy. In Figure 10 it is seen that 14 per cent of white women had vascular spiders by the second month of pregnancy. For the next 3 months there was a general tendency for the proportion having spiders to increase rapidly. Following this there was a slow but steady increase of positive cases up to the time of delivery. By the ninth month of pregnancy 66 per cent of all white women under observation had vascular spiders. We do not have all the control observations desirable on incidence of vascular spi-

The discrepancies between the numbers in the text and those in Figures 10, 11, 12, and 13 have resulted from our using data from completely observed cases in the charts—women seen prenatally at and after delivery and the routine postnatal follow-up. Numbers in the text are derived from all records with relevant information, even if follow up is lacking. No difference has been more than 5 per cent.

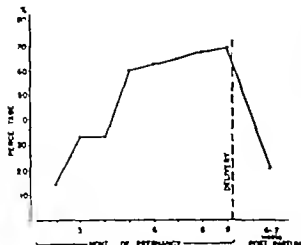


Fig. 11. Percentage of white women with vascular spiders during and after pregnancy.

ders in unmarried childless or parous women of various ages. In order to get some idea of their incidence in a representative group of women we observed 58 nonpregnant white women who had one or more children and found typical vascular spiders in 12 per cent. While the number of women without a history of pregnancy might well supply a lower figure the percentage of white women with spiders during pregnancy is significantly and markedly higher than the control group of nonpregnant women who had borne children. Other control observations are given in Table I.

Nine white women had vascular spiders which they were certain had existed before the first pregnancy.

Findings in negro women are different, chiefly in the much lower incidence of vascular spiders in members of this race. In Figure 12 we find that no spiders were observed prior to the fourth month by which time they had appeared in 8 per cent of all subjects seen during this month. The incidence rose slowly thereafter until a peak was reached in the ninth month when 14.2 per cent were found to have spiders.

This notable discrepancy between incidence in white and negro women highlights an aspect of the study in which we have correlated the depth of skin pigmentation with the finding of vascular spiders among both white and negro women. An estimate of degree of pigmentation of the skin was made on each person and

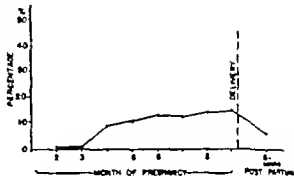


Fig. 12. Percentage of negro women with vascular spiders during and after pregnancy.

recorded as light, medium, and dark. White women with red hair were recorded in a separate category. This was checked at each clinic visit without access to previous estimate of pigment by the observer. While this is at best only a semiquantitative evaluation there was surprising consistency in the routine observations by each member of the study group and good consistency between different observers. In Figure 12 we have charted the percentage of women with different depths of skin pigment in whom we observed vascular spiders. There was a consistent tendency for them to be found more often in those with skin of lighter color. This may indicate merely the obvious fact that vessels in the skin can be seen more readily in persons with light skin but the additional possibility exists that there is a greater tendency for such vascular lesions to develop in women with light skin. There was a similar trend among negro women whose depth of skin pigment was recorded as light, medium, or dark.

In Figures 10 and 11 the highest incidence of vascular spiders in white and negro women during the last month of pregnancy is compared with their incidence at the regular postpartum follow up. In white women the percentage fell from 69 to 20. In negroes the corresponding change was from 14 to 5 per cent. Thus about three-fourths of the women who had vascular spiders in the ninth month of pregnancy had lost them by the seventh week after delivery. In Figure 13 we have given in detail the rate at which vascular spiders and palmar erythema were lost during the last month of pregnancy and during the puer-

TABLE I.—INCIDENCE OF VASCULAR SPIDERS AND PALMAR ERYTHEMA IN CONTROL GROUPS

	Number	Negative %	Spiders %	Palmar erythema %
Normal white women	58	86.2	12.0*	8.1*
Normal negro women	57	95.0	0.0	4
Normal white soldiers	205	85.2	14.0	0
Normal negro soldiers	42	100		
Lecnon's dermatitis	5	5	75	4 †

\*Spiders and palmar erythema occurred together in 3.4 per cent.

†Data not complete.

perum Data are derived from all subjects with observations, regardless of follow up. A few women suddenly lost vascular spiders, or they decreased in size during the month before delivery, but this was uncommon. The period of most rapid loss of spiders was during the week immediately following delivery. The loss thereafter was more gradual up to the time of our final observation. In the few women whom we have seen up to a year after delivery there has been a further decrease in size and number of lesions unless another pregnancy intervened. In Figures 10 and 11 the data for disappearance refer to women who had lost all vascular spiders. In those still positive at the postpartum check up many had lost some but not all of the lesions and in others they had decreased in size so the quantitative aspects of the changes were even more dramatic than is suggested from the figures. There was a tendency for lesions which appeared late in pregnancy to fade early and those which appeared early to disappear some-

TABLE II.—DISTRIBUTION OF SPIDERS IN WHITE AND NEGRO WOMEN

Area	White (30 lesions) %	Negro (05 lesions) %
Face		
Neck and anterior chest	4	5
Arm, upper anterior	7	5
Arm, upper posterior	8	3
Arm, lower anterior	4	9
Arm, lower posterior		7
Palm	7	20
Dorsum of hand	5	20
Others	(lose 1 case)	

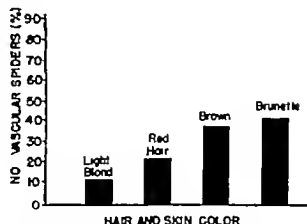


Fig. 12. Percentage of white women with different hair and skin color having no vascular spiders.

what later. This is partly related to size of individual spiders the larger ones usually taking longer to vanish completely. Without charts marking the area of each lesion and photographic records usually it was impossible to identify precisely the area where a spider had been. At times a small freckle marked the spot and at times the skin was slightly atrophic, but these were exceptional findings. In 3 instances we noted spiders after delivery which were not recorded before. We believe this represents an earlier oversight rather than the actual development of new lesions during the puerperium.

In Table II we have compared the location of vascular spiders in white and negro women. There are notable differences. In negroes the hand was the site of about half the spiders whereas in white women it was the site of only a quarter of the lesions. The difference was even more striking where the palm was considered lesions being almost three times as common on the palm in negro women as in white women. The other findings are given in the table. Aside from differences in pigmentation we have no ready explanation for these contrasts.

## OBSERVATIONS PALMAR ERYTHEMA

Palmar erythema was observed in a total of 300 or 62.5 per cent of the white women and 263 or 35 per cent of the negro women in this study. Figures 14 and 15 give the incidence throughout pregnancy and by the time of the postpartum follow up. The trend of appearance of palmar erythema in figure 14 was

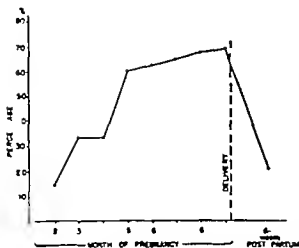


Fig. 10. Percentage of white women with vascular spiders during and after pregnancy.

ders in unmarried childless, or parous women of various ages. In order to get some idea of their incidence in a representative group of women we observed 58 nonpregnant white women who had one or more children and found typical vascular spiders in 12 per cent. While the number of women without a history of pregnancy might well supply a lower figure the percentage of white women with spiders during pregnancy is significantly and markedly higher than the control group of nonpregnant women who had borne children. Other control observations are given in Table I.

Nine white women had vascular spiders which they were certain had existed before the first pregnancy.

Findings in negro women are different, chiefly in the much lower incidence of vascular spiders in members of this race. In Figure 11 we find that no spiders were observed prior to the fourth month by which time they had appeared in 8 per cent of all subjects seen during this month. The incidence rose slowly thereafter until a peak was reached in the ninth month when 14.2 per cent were found to have spiders.

This notable discrepancy between incidence in white and negro women highlights an aspect of the study in which we have correlated the depth of skin pigmentation with the finding of vascular spiders among both white and negro women. An estimate of degree of pigmentation of the skin was made on each person and

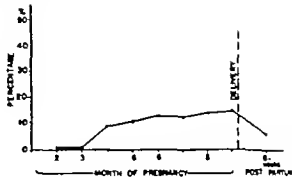


Fig. 11. Percentage of negro women with vascular spiders during and after pregnancy.

recorded as light, medium and dark. White women with red hair were recorded in a separate category. This was checked at each clinic visit without access to previous estimate of pigment by the observer. While this is at best only a semiquantitative evaluation there was surprising consistency in the routine observations by each member of the study group and good consistency between different observers. In Figure 12 we have charted the percentage of women with different depths of skin pigment in whom we observed vascular spiders. There was a consistent tendency for them to be found more often in those with skin of lighter color. This may indicate merely the obvious fact that vessels in the skin can be seen more readily in persons with light skin but the additional possibility exists that there is a greater tendency for such vascular lesions to develop in women with light skin. There was a similar trend among negro women whose depth of skin pigment was recorded as light, medium or dark.

In Figures 10 and 11 the highest incidence of vascular spiders in white and negro women during the last month of pregnancy is compared with their incidence at the regular postpartum follow up. In white women the percentage fell from 60 to 20. In negroes the corresponding change was from 14 to 5 per cent. Thus about three-fourths of the women who had vascular spiders in the ninth month of pregnancy had lost them by the seventh week after delivery. In Figure 13 we have given in detail the rate at which vascular spiders and palmar erythema were lost during the last month of pregnancy and during the post-







TIME OF DISAPPEARANCE	3	4	5	6	7	8	9	TOTAL
STILL PRESENT			1		1		1	3%
7 WEEKS POST-PARTUM	1	2	1	1	3	2	7	17%
1-7 DAYS POST-PARTUM		2	3	8	6	8	18	42%
24 HOURS AFTER DELIVERY			1	3	5	5	14	28%
LAST WEEK OF PREGNANCY				2	3	4	1	0%

Fig. 16 Comparison of the month of appearance and the time of disappearance of palmar erythema.

spiders. Palmar erythema tended to fade more rapidly in negro than in white women (Fig. 13). We believe that the change in the vessels in the palm is more labile and has a considerable functional element. The distribution and intensity of the redness change from time to time. There is some spontaneous variation in the combinations of mottled erythema, cyanosis and pallor in many instances. There is a more abrupt onset and fading is complete in more women at the time of follow up.

We have found no explanation for the fact that either palmar erythema or vascular spiders may occur alone or in association with the other. Palmar erythema was observed in 67 per cent of the white women who had vascular spiders. Vascular spiders were observed in 71 per cent of the white women who exhibited palmar erythema. Thus if either type of vascular change was found the other was about twice as likely to be present as to be absent. This suggests but does not prove that there may be a common cause. In Figure 17 we have plotted the known month of appearance of vascular spiders and of palmar erythema. There is a tendency for them to occur near the same time but there are notable exceptions. Further data are needed to determine whether the tendency for palmar erythema to appear before spiders in negro women and the reverse in white women is substantiated. Their parallel course of increase in intensity throughout gestation and similar rapid decrease or disappearance is further support for this idea. One may suggest that the sites affected i.e. palms or other parts of the body are determined by inherent properties of the

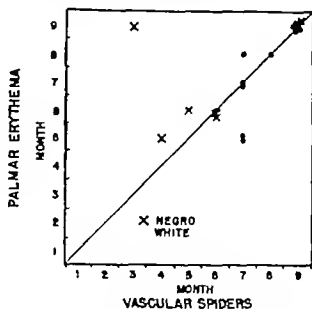


Fig. 17 Comparison of known month of appearance of palmar erythema and vascular spiders. Each point or x represents 1 case.

vessels to react to the stimulus which provokes the change. This may be a genetic peculiarity though we have no proof that this is the case. In a few women observed in two or more pregnancies we have found a tendency for one or the other type of lesion to recur. There have been exceptions. Thus the supposition that there is only one mechanism at work in pregnancy which evokes vascular spiders or palmar erythema or both is far from established though the natural history of the phenomena points in this direction.

#### OTHER OBSERVATIONS

Although we did not see any clinical indication of hepatic disease complicating pregnancy we carried out some liver function studies on 26 white women in the present investigation to see whether there was any laboratory evidence of impaired function or any difference in those with vascular spiders or palmar erythema and those without such vascular changes. The icterus index, bromsulphalein retention (at 45 minutes after 5 mgm per kgm), cephalin cholesterol flocculation and thymol turbidity tests were performed in the third trimester of pregnancy. Those tests did not reveal any significant sign of hepatic damage and the very minor deviations from normal were found regardless of presence or absence of vascular spiders or palmar erythema or both. There

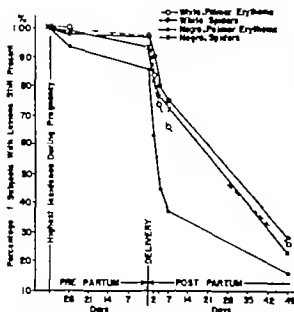


Fig. 3. Rate of disappearance of vascular spiders and palmar erythema expressed as per cent. Subjects were called positive when either type of palmar erythema was noted, or one or more spiders. They were classified as negative when all vascular spiders or the palmar erythema had disappeared.

considerably different from that for vascular spiders in Figure 10. While only 24 per cent of the white women seen in the second month of pregnancy had vascular spiders, palmar erythema was present in 33 per cent at that time. From the second through the ninth month there was a gradual rise. The dip in the curve from the third to the fourth month does not mean that some women lost their palmar

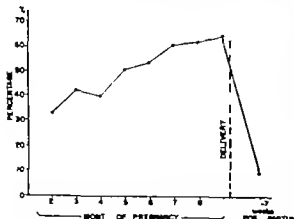


Fig. 4. Percentage of white women exhibiting palmar erythema during the course of pregnancy and after delivery.

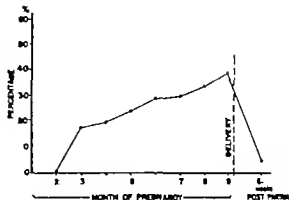


Fig. 5. Percentage of negro women exhibiting palmar erythema during the course of pregnancy and after delivery.

erythema during this time but that it was less common in the women making their first clinic visit during the fourth month. By the time of the regular postpartum visit palmar erythema had faded in all but 9 per cent of the women. This compares with 20 per cent who retained vascular spiders at this time. Three white women had palmar erythema before the onset of the first pregnancy and in two it existed in other members of their family.

In Figure 15 the curve for incidence of palmar erythema in negro women is given. This may be compared with a similar curve for vascular spiders in Figure 11. While no instance was found in the second month, palmar erythema had appeared in 17 per cent by the third month, and there was a slow but steady rise to a peak of 39 per cent by the ninth month. This had fallen to 4 per cent by the postpartum follow-up. Palmar erythema was almost three times as common as vascular spiders in negro women while there was only a slight difference in the incidence of vascular spiders and palmar erythema in white women. The most probable cause is the variation in skin pigment which is much less deep in the palms than in other areas of skin of negro women.

In Figure 16 the time of appearance has been compared with the time of fading of palmar erythema. There is an indication that the lesion appearing late fades early and vice versa. In 10 per cent the lesions disappeared before or during the last week of pregnancy a larger proportion than in the case of vascular

TIME OF DISAPPEARANCE	3	4	5	6	7	8	9	TOTAL
STILL PRESENT			1		1		1	3%
7 WEEKS POST-PARTUM	1	2	1	1	3	2	7	17%
1-7 DAYS POST-PARTUM		2	3	8	6	8	15	42%
24 HOURS AFTER DELIVERY			1	3	5	5	14	28%
LAST WEEK OF PREGNANCY				2	3	4	1	0%
	3	4	5	6	7	8	9	

Fig. 16 Comparison of the month of appearance and the time of disappearance of palmar erythema

spiders. Palmar erythema tended to fade more rapidly in negro than in white women (Fig. 13). We believe that the change in the vessels in the palm is more labile and has a considerable functional element. The distribution and intensity of the redness change from time to time. There is some spontaneous variation in the combinations of mottled erythema, cyanosis and pallor in many instances. There is a more abrupt onset and fading is complete in more women at the time of follow up.

We have found no explanation for the fact that either palmar erythema or vascular spiders may occur alone or in association with the other. Palmar erythema was observed in 67 per cent of the white women who had vascular spiders. Vascular spiders were observed in 71 per cent of the white women who exhibited palmar erythema. Thus if either type of vascular change was found the other was about twice as likely to be present as to be absent. This suggests but does not prove that there may be a common cause. In Figure 17 we have plotted the known month of appearance of vascular spiders and of palmar erythema. There is a tendency for them to occur near the same time but there are notable exceptions. Further data are needed to determine whether the tendency for palmar erythema to appear before spiders in negro women and the reverse in white women is substantiated. Their parallel course of increase in intensity throughout gestation and similar rapid decrease or disappearance is further support for this idea. One may suggest that the sites affected, i.e. palms or other parts of the body, are determined by inherent properties of the

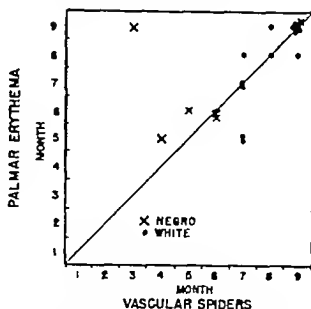


Fig. 17 Comparison of known month of appearance of palmar erythema and vascular spiders. Each point or x represents 1 case

vessels to react to the stimulus which provokes the change. This may be a genetic peculiarity though we have no proof that this is the case. In a few women observed in two or more pregnancies we have found a tendency for one or the other type of lesion to recur. There have been exceptions. Thus the supposition that there is only one mechanism at work in pregnancy which evokes vascular spiders or palmar erythema or both is far from established though the natural history of the phenomena points in this direction.

#### OTHER OBSERVATIONS

Although we did not see any clinical indication of hepatic disease complicating pregnancy, we carried out some liver function studies on 26 white women in the present investigation to see whether there was any laboratory evidence of impaired function or any difference in those with vascular spiders or palmar erythema and those without such vascular changes. The icterus index, bromsulphalein retention (at 45 minutes after 5 mgm per kgm), cephalin cholesterol flocculation and thymol turbidity tests were performed in the third trimester of pregnancy. Those tests did not reveal any significant sign of hepatic damage and the very minor deviations from normal were found regardless of presence or absence of vascular spiders or palmar erythema or both. There

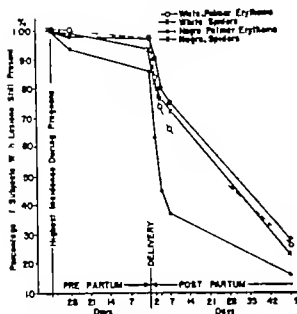


Fig. 13. Rate of disappearance of vascular spiders and palmar erythema expressed as per cent. Subjects are called positive when either type of palmar erythema was noted, or one or more spiders. They were called as negative when all vascular spiders or the palmar erythema had disappeared.

considerably different from that for vascular spiders in Figure 10. While only 14 per cent of the white women seen in the second month of pregnancy had vascular spiders, palmar erythema was present in 33 per cent at that time. From the second through the ninth month there was a gradual rise. The dip in the curve from the third to the fourth month does not mean that some women lost their palmar

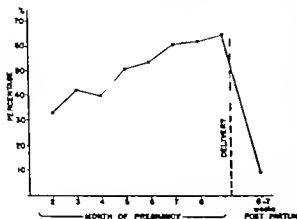


Fig. 14. Percentage of white women exhibiting palmar erythema during the course of pregnancy and after delivery.

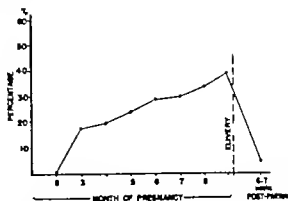


Fig. 15. Percentage of negro women exhibiting palmar erythema during the course of pregnancy and after delivery.

erythema during this time but that it was less common in the women making their first clinic visit during the fourth month. By the time of the regular postpartum visit palmar erythema had faded in all but 9 per cent of the women. This compares with 20 per cent who retained vascular spiders at this time. Three white women had palmar erythema before the onset of the first pregnancy and in two it existed in other members of their family.

In Figure 15 the curve for incidence of palmar erythema in negro women is given. This may be compared with a similar curve for vascular spiders in Figure 11. While no instance was found in the second month, palmar erythema had appeared in 17 per cent by the third month and there was a slow but steady rise to a peak of 39 per cent by the ninth month. This had fallen to 4 per cent by the postpartum follow-up. Palmar erythema was almost three times as common as vascular spiders in negro women while there was only a slight difference in the incidence of vascular spiders and palmar erythema in white women. The most probable cause is the variation in skin pigment which is much less deep in the palms than in other areas of skin of negro women.

In Figure 16 the time of appearance has been compared with the time of fading of palmar erythema. There is an indication that the lesion appearing late fades early and vice versa. In 10 per cent the lesions disappeared before or during the last week of pregnancy a larger proportion than in the case of vascular

TIME OF DISAPPEARANCE	3	4	5	6	7	8	9	TOTAL
STILL PRESENT			1		1		1	3%
7 WEEKS POST-PARTUM	1	2	1	1	3	2	7	17%
1-7 DAYS POST-PARTUM		2	3	8	8	6	15	48%
24 HOURS AFTER DELIVERY			1	3	5	5	14	28%
LAST WEEK OF PREGNANCY				2	3	4		10%
	3	4	5	6	7	8	9	
	MONTH OF ONSET DURING PREGNANCY							

Fig. 16 Comparison of the month of appearance and the time of disappearance of palmar erythema.

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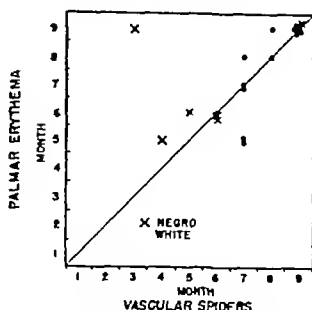


Fig. 17 Comparison of known month of appearance of palmar erythema and vascular spiders. Each point or x represents 1 case.

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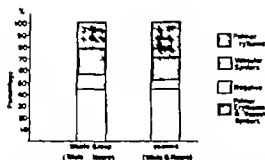


Fig. 8. A comparison of the incidence of vascular spiders, palmar erythema or both in women with toxemia compared with the whole group.

was no indication that damage to the liver comparable to that usually found in chronic cirrhosis, existed in the pregnant women in this study. Nothing suggested that vascular lesions in pregnancy have been caused by hepatic malfunction.

Although all the data have not been analyzed regarding age of the mother, number of pregnancies, sex and viability of offspring and lactation with reference to the incidence and number of vascular spiders, and the incidence, type and degree of palmar erythema, our studies so far indicate no striking relationships. Thus the vascular changes in the skin had no notable association with first or later pregnancies, with male or female offspring with age or youth of the mother with lactation or its failure to occur or to continue properly. We have studied hypertension and toxemias more extensively since there is some evidence and more belief that humoral factors play a part in their genesis. Patients having systolic blood pressure of more than 140 millimeters of mercury and diastolic blood pressure of more than 90 millimeters of mercury were classed as hypertensives. Hypertensive patients with albuminuria, edema, symptoms of headaches, etc. or convulsions in the third trimester of pregnancy were classed as toxemias. In 1145 of the patients studied so far there were 24, or 2.1 per cent with hypertension during pregnancy. In another 99 or 8.7 per cent, there was toxemia. These diagnoses were made by members of the obstetrical staff independently of our own studies, and the data were combined only after the records were complete. The number with hypertension was too small to have much significance,

but even in this group the incidence of vascular spiders or palmar erythema, or the two in combination was very nearly the same as in the whole group. Since the number with toxemia were larger we have compared the incidence of vascular spiders and palmar erythema in this group with the incidence in the entire series in Figure 18. While there are slight differences the figures agree so nearly that we conclude that the changes in the skin we have observed have no essential relation to toxemia or its absence.

#### GENERAL CONSIDERATIONS

The studies we have carried out indicate that vascular spiders and palmar erythema, alone or in combination are found frequently as accompaniments of normal pregnancy. Since the investigation was intensive and persistent we discovered many lesions of which the subjects were wholly unaware. Many however were obvious and had been noticed, and in some persons they were the source of embarrassment or worry.

Since vascular spiders or palmar erythema may be found in normal nonpregnant women we have been particularly interested in their fate after pregnancy since our control observations do not include women in a wide range of ages who had never been pregnant. Such observations as we have made (Table I) indicate that a vascular spider may be found in about 10 per cent of white women who have borne children. In a study made by one of us during a nutrition survey of American troops in various islands in the Pacific during World War II it was found that vascular spiders were seen in 14.9 per cent of the white and in none of the negro soldiers. Even with these as a base line there is a marked and consistent increase in the number of women with vascular spiders and in the number of spiders per woman from the second or third month of pregnancy until term. At this time there is a sudden decrease in size of individual lesions, a complete disappearance of many so that by the seventh week after childbirth the number approaches that found in control groups. Subsequently there is a further decrease which apparently continues slowly so long as another pregnancy does not occur.

This study serves as a companion for similar investigations on vascular spiders and palmar erythema in persons suffering with chronic hepatic disease (4-6). Although the number of patients with hepatic disease was relatively small it was ample to establish the fact that both spider nevi and palmar erythema may appear as complications of chronic or subacute disease of the liver. If and when the state of the liver improves these vascular changes may recede just as they do following the completion of gestation, though rarely with such dramatic suddenness. Vascular spiders in well established cirrhosis are usually larger and occur in greater numbers than in pregnant women. Their similar distribution over the upper part of the body, their similar shape, the palpable pulsation and intravascular pressure of 50 to 80 millimeters of mercury are strong indications of their kinship. We have not had an opportunity to observe a woman who had known of vascular spiders during a pregnancy who later had them with chronic liver disease nor have we encountered a woman with cirrhosis who became pregnant though some with ascites suspected pregnancy. Nor have we compared the histologic picture of the lesions in cirrhosis with those of pregnancy. We are however convinced that there is no fundamental difference between those which appear in pregnancy and those which appear in cirrhosis. It has been suggested that a possible common factor in normal pregnancy and chronic liver disease might be a high level of circulating estrogenic hormones (3) or related endocrine substances perhaps of adrenal origin (6). The fact that we have been able to find no significant abnormality of hepatic function in pregnant women with palmar erythema and vascular spiders as compared with those who do not have them suggests that disturbed liver function in pregnancy is not responsible for their occurrence.

As collateral testimony that estrogenic hormones may produce an effect on the vessels of the skin qualitatively similar to the well documented effect on vessels of the uterus we have superimposed Venning's (27-28) curve of estrogen excretion throughout pregnancy upon our figures for the incidence of vascular spiders and palmar erythema in white and negro

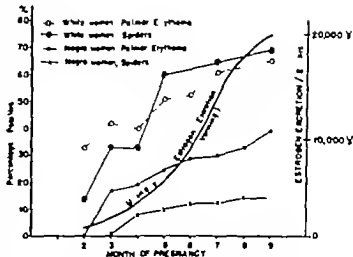


Fig. 19. A comparison of the incidence of vascular spiders and palmar erythema with the urinary excretion of estrogens (Venning) during pregnancy.

women during pregnancy (Fig. 19). Although the forms of the curves do not agree with precision there is a similarity. Evidence for the critical early months is inadequate for analysis. Crucial data in individual patients must be obtained in the future. There is however no established finding which invalidates the hypothesis that humoral agents with estrogenic function give rise to vascular changes in the skin during the course of normal pregnancy and during the active stage of chronic liver disease.

Our studies have established the rather surprising frequency of the vascular spider and palmar erythema as banal accompaniments of normal pregnancy. We have advanced the hypothesis that these phenomena may be caused by hormones and have implicated the estrogenic substances in particular. The facts we have recorded should be known to obstetricians if only for the occasional comfort they bring to women whose worry about such blemishes may add its needless burden to the trials of pregnancy. The speculations must stand or fall according to the results of hormone assays we now have under way.

#### SUMMARY

1. We have presented an interim analysis of data concerning the incidence, natural history, and fate of vascular spiders and palmar erythema as observed in 1243 women in the obstetrical clinic of the Cincinnati General Hospital.



2 The literature on these cutaneous vascular changes has been reviewed. Vascular spiders apparently were first noticed as a benign complication of normal pregnancy by Corbett in 1914 and have been recorded by dermatologists and internists at intervals since then. The first note on palmar erythema of pregnancy which we have found was published by Feldman in 1939. No word about such lesions has been found in the American textbooks on obstetrics which we have consulted.

3 Vascular spiders have been found in about two-thirds of the white women and 11 per cent of the negro women during pregnancy. They tend to appear in the early months of pregnancy especially during the second through the fifth months. They increase slowly in number and in size until term or shortly before. About three-fourths of them have faded by the seventh week after delivery.

4 Details of the vascular spider of pregnancy have been presented in photographs of the involved skin before and after delivery and demonstrate the rapid return to normal.

5 Two types of palmar erythema have been described and photographs presented.

6 Almost two-thirds of the white women and slightly more than one-third of the negro women were observed to have palmar erythema during pregnancy. The appearance and the fading were more abrupt than with vascular spiders but the trends of appearance and disappearance were similar.

7 While the difference in incidence of the cutaneous vascular changes in white and negro women was large we have suggested that other factors than skin pigment alone may be involved. The depth of skin color is a major consideration. Vascular spiders and palmar erythema have not been reported in negroes during pregnancy heretofore.

8 Tests of liver function did not reveal significant abnormality or differences between those with and without spiders or palmar erythema.

9. There was no marked difference in incidence or number of vascular spiders or of

palmar erythema between subjects who later developed toxemia and those who escaped it.

10 We have compared the vascular spider of pregnancy with that found in chronic liver disease and find no basic differences. They are apt to be larger and more numerous in persons with cirrhosis than in pregnant women.

11 We have advanced the hypothesis that vascular spiders and palmar erythema develop as a response to the stimulus of high levels of estrogenic substances circulating in the blood for long periods. Studies are in progress to test its validity.

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# THORACIC COMPLICATIONS OF AMEBIASIS

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AMEBIASIS is a disease which is of interest to the internist, the general surgeon, and the surgeon who is limiting his practice to thoracic diseases. Although the disease in its incipency is an intestinal infestation, there are complications which may require surgical relief. The treatment of the intestinal infestation is entirely a medical problem. The complication of an hepatic abscess, however, although best treated by medical measures, should be conducted under the observation of a surgeon, since surgical management of the abscess may become necessary if further complications set in. The hepatic abscess in turn may cause complications within the thorax which may require the services of a surgeon trained in the treatment of thoracic diseases. Surgery may be necessary to eliminate fistulous channels between the liver and bronchi left by the infection, to re-expand an imprisoned lung, or to remove damaged pulmonary tissue. Due to the increasing tendency to resect pulmonary tissue for pulmonary suppuration, occasionally the diagnosis of amebic pulmonary suppuration may not be suspected until the time of operation. Now that more meticulous technique is possible in pulmonary resection and decortication, the high mortality (33 per cent) previously reported by Ochsner and DeBakey (2) for surgery in this type of infection need not be feared. Four patients having thoracic complications of amebiasis treated during the past 2 years by various surgical procedures will be reported in this paper. Another patient having a complicating pericarditis from an amebic hepatic abscess who was treated by my associate will be briefly discussed. All of these patients have completely recovered from the hepatic abscess and its complications.

## INCIDENCE

The general incidence of infestation with the *Endamoeba histolytica* is much higher in the

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general population than is usually realized. Statistics obtained from surveys a few years ago would probably not now be even high enough, since during the war so many men in the military forces saw service in areas where amebic dysentery was a very common disease. Craig estimated the prevalence of infestation in the population at large at from 5 to 10 per cent. There have been surveys that have cited the incidence as high as 33 per cent. Ochsner and DeBakey (3) in their writings upon this subject believe that an incidence of 20 per cent is a reasonable figure. It has been found that hepatic abscesses will complicate infestations with the *Endamoeba histolytica* in approximately 5 per cent of all cases. Further, more there will be complications within the thoracic cage in approximately 15 per cent of patients having hepatic abscesses. The sex incidence has never been adequately explained in the case of hepatic abscesses. Males predominate over females in the occurrence of this complication in a ratio of 15 to 1. The age incidence is also of some interest, since it has been found that the majority of patients having hepatic abscesses fall between the ages of 20 to 50 years.

## PATHOLOGY

Amebic abscesses of the liver undoubtedly occur due to the migration of the parasites through the portal system into the liver. Here the parasites clog the small capillaries and venules and set up a lytic process which destroys tissue. A small abscess develops and the necrotic zone of the liver tissue surrounding the abscess pours fluid and debris into the abscess cavity. The amebae are usually best found deep within the wall of the abscess, very close to the healthy liver tissue. The abscesses are single in approximately 65 to 88 per cent of the cases (3). In cases in which the abscesses are multiple, there may be coalescence of the abscesses, but if this fails to occur, the prognosis is much more grave. Approximately 85 to 96 per cent (3) of all hepatic abscesses of



Fig. a.



Fig. b.

Fig. Hepatic abscess which has ruptured into middle lobe. a, Elevated right diaphragm. 1th dense shadow in right lower lung field. b, The middle lobe is contracted and the dense shadow. 1th is shifted into the shadow cast by the elevated 1th or 2nd diaphragm. 1th shadow outlines both the hepatic and pulmonary cavities.



Fig. c.

the liver are found within the right lobe of the liver probably because of the size of this lobe as compared with the left lobe. The thoracic complication comes about because of a direct extension of the abscess through the dia-

phragm into the pleural cavity or directly into the lung through adhesions that have been formed because of the inflammatory process. If the abscess is in the left lobe of the liver the extension of the abscess may be into the pericardial sac causing a pericarditis. Pleuropulmonary complications on the left seldom occur. There have been described in the literature solitary abscesses within the lung substance which are not adjacent to the diaphragm. It must be postulated that these abscesses are embolic in origin and that the abscesses reached the pulmonary circulation by going through the hemorrhoidal veins into the vena caval system or by anastomotic channels between the venules of the portal and the vena caval systems within the liver. Abscesses of this type are the exception.

#### SYMPTOMATOLOGY

In approximately 50 per cent of all cases of pleuropulmonary complications from hepatic



Fig. 2a.

Fig. 2. Hepatic abscess which has ruptured into right lower lobe. a Posteroanterior view shows abscess in base of right lung. b Lateral view shows the shadow cast by the pulmonary abscess to be continuous with the right diaphragmatic outline. c, Ten days following resection of lower lobe and repair of diaphragm.



Fig. 2b.

abscesses there will be no history of a previous dysentery. The most usual complaint of a patient having a pleuropulmonary complication is pain in the lower right chest and in the shoulder. There is a cough which early is not productive. Later there is usually an episode of hemoptysis which then gives way to the coughing up of sputum which is described as being like chocolate or anchovy paste. A septic type of fever with or without chills will always be present. The patient also suffers from the usual signs of infection i.e. anorexia, malaise and weakness. There may be extreme weight loss.

#### ROENTGENOGRAPHIC APPEARANCE

The roentgenographic appearance of the chest is characteristic enough to be almost diagnostic in cases of thoracic complications from amebic hepatic abscesses. There is a bump like localized elevation of the diaphragm

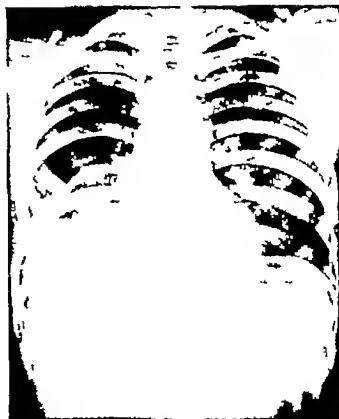


Fig. 2c.

which is usually best seen in the lateral view (Figs. 2b and 4b). If there has been perfora

tion of the abscess directly into the pulmonary tissue there will be present a shadow in the base of the involved lobe with the apex of the shadow tapering off toward the pulmonary hilum (Figs. 1b and 2b). There may or may not be an annular shadow with a fluid level indicating a pulmonary abscess depending upon the amount of pulmonary tissue destruction and whether the communicating bronchus will admit air to the pulmonary abscess. In case of a complicating empyema there will be the appearance of pleural fluid. A pyopneumothorax may be present at the time of the first examination if a bronchus is open into the pleural space. Since the lung is adherent to the diaphragm the collection of pleural exudate may be more lateral than basal (Fig. 3b). Loculation of the pleural exudate is a common occurrence with amebic empyema (Fig. 4a). An hepatic abscess in the left lobe of the liver can be suspected if a roentgenogram of the abdomen following barium by mouth reveals the stomach to be displaced posteriorly and laterally. A widened pericardial shadow would indicate possible rupture into the pericardial sac.

#### PROGNOSIS

The prognosis of pleuropulmonary complications of an hepatic abscess due to the *Endamoeba histolytica* vary with the type of complication. The prognosis is much more severe if an empyema results. Ochsner and DeBakey (2) reported that in a collected series of empyema complicating hepatic abscesses the mortality was 77.7 per cent. In their own series the mortality was 66.6 per cent. The mortality was lower when a pulmonary abscess developed without the occurrence of an empyema. In this case it was 42.2 per cent in the collected series and 22.2 per cent in their series. The lowest mortality occurred when a bronchohepatic fistula developed without the occurrence of either empyema or pulmonary abscess. There was a mortality of 10 per cent in the collected series in this type of complication and no mortality in the series reported by Ochsner and DeBakey. This mortality was greatly reduced when emetine therapy was given. In the 153 patients in the collected series with pleuro-

pulmonary complications the mortality of 56.6 per cent when emetine was not used dropped to 9.1 per cent with emetine therapy. In the series reported by Ochsner and DeBakey (2) there was 60 per cent mortality without the use of emetine and no mortality when emetine was used. Ochsner and DeBakey (2) also further warned against unnecessary surgical drainage procedures in the case of hepatic abscesses and their pleuropulmonary complications. They showed that there was a 33 per cent mortality in the patients upon whom operations had been performed. They deserve much credit for pointing out the efficacy of emetine therapy in hepatic abscesses and their pleuropulmonary complications. With present techniques and with chemotherapy however surgery if necessary is safer than these authors indicate.

#### TREATMENT

Emetine is a specific drug for the hepatic abscess caused by the *Endamoeba histolytica*. Even after a pleuropulmonary complication has occurred, emetine should be used in an attempt to avoid surgery and in conjunction with surgery should surgical interference become necessary. Emetine is a drug which must be used with extreme care because of its toxicity for cardiac muscle. Under ideal conditions an electrocardiogram should be made before treatment is instituted. A course of therapy should then be instituted once the diagnosis of an hepatic abscess has been established giving 1 grain doses intramuscularly daily for 6 to 10 days. Following this course of treatment the electrocardiographic tracings should be repeated to determine whether or not there has been myocardial damage. If the patient also has signs of amebic dysentery, such drugs as carbarsone and diiodoquin should be administered. It should be remembered however that this type of drug is toxic to the liver and should be used very cautiously if there are signs of extreme liver damage due to the abscess. In conjunction with the emetine therapy the abscess cavity within the liver should be aspirated if this is possible. If there is tenderness and bulging of the lower costal margin due to the presence of the abscess, aspiration with a long needle with an

adequate lumen should be attempted in the most tender area. If pus is obtained as much of the pus as possible should be aspirated. The aspiration of the abscess not only serves the purpose of evacuating the cavity but also draws fluid from the liver into the abscess cavity and by doing this also causes the amebas to migrate toward the abscess cavity where they in turn will be removed at a subsequent aspiration. This drawing of fluid into the abscess cavity also allows the emetine to come in better contact with the amebas within the wall of the abscess. Aspirations of the abscess cavity should be repeated until a significant amount of pus cannot be obtained. As a rule even though the hepatic abscess has ruptured through the diaphragm into the pulmonary tissue and has found an outlet through the bronchial tree the cough and expectoration will promptly cease after the evacuation of the abscess by aspiration and the treatment with emetine.

#### INDICATIONS FOR SURGERY

Surgical interference becomes necessary in amebic hepatic abscesses which have caused pleuropulmonary complications if (1) secondary infection has occurred (2) an empyema has resulted which cannot be cured by repeated aspirations (3) a persistent abnormal channel between the bile duct system and bronchi persists (4) fibrosis of pulmonary tissue as result of the abscess continues to be symptom-producing.

The most common indication for drainage of the hepatic abscess will be secondary infection. Once an abscess in the liver due to the *Endamoeba histolytica* has become secondarily infected by pyogenic organisms it must be drained. This drainage can usually be accomplished through an extraperitoneal route. Complications within the peritoneum and pleura will be thus avoided. One of the most serious and annoying complications of drainage of an hepatic abscess is the gangrenous infection of the skin and subcutaneous tissue which may result. This complication occurred in Case 1 of the present report. If this complication results it is necessary to excise the gangrenous tissue entirely down to healthy tissue. This may require the excision of a

considerable amount of skin and the raw surface may have to be covered by skin grafting at a later date.

Pleuropulmonary complications are usually best handled by thoracotomies employing reparative surgery without external drainage. In the case of an empyema which will not clear with repeated aspirations a thoracotomy can be done and a decortication of the lung and diaphragm performed. In the course of this decortication it will be necessary to close the opening in the diaphragm. As a rule the hepatic abscess has erupted into the pleural cavity or pulmonary tissue in such a way that the abscess has practically healed itself. It is not necessary in these cases to employ subsequent counterdrainage for the hepatic abscess. Resection of damaged pulmonary tissue will be necessary. In most cases this will require no more than a wedge resection of the fistulous area. In other cases however it may be preferable to remove an entire lobe. After the products of the infection have been as cleanly removed from the chest as possible the pleural cavity should be drained with an intercostal drain connected to a negative pressure system. The chest is then closed.

Rupture of an hepatic amebic abscess through the pericardium into the pericardial sac is a serious complication and as judged by review of the literature has usually proved fatal. With prompt treatment recovery is possible. Aspiration of the pericardial exudate and emetine therapy should be carried out immediately. This may be all that will be required to bring about recovery. Other complications may ensue which will require surgery. My associate (4) while in the medical corps during the late World War had under his care a soldier who developed an hepatic abscess of the left lobe of the liver. The abscess ruptured into the pericardial sac and peritoneal space beneath the left leaf of the diaphragm. The subdiaphragmatic space was drained anteriorly. It was soon evident that the abscess had perforated the wall of the stomach and a gastric fistula resulted. Posterior drainage was later instituted through resection of the 9th and 10th ribs in the mid axillary line. Eventually the gastric fistula closed and all draining sinuses healed. Eme

tion of the abscess directly into the pulmonary tissue there will be present a shadow in the base of the involved lobe with the apex of the shadow tapering off toward the pulmonary hilum (Figs. 1b and 2b). There may or may not be an annular shadow with a fluid level indicating a pulmonary abscess depending upon the amount of pulmonary tissue destruction and whether the communicating bronchus will admit air to the pulmonary abscess. In case of a complicating empyema there will be the appearance of pleural fluid. A pyopneumothorax may be present at the time of the first examination if a bronchus is open into the pleural space. Since the lung is adherent to the diaphragm the collection of pleural exudate may be more lateral than basal (Fig. 3b). Loculation of the pleural exudate is a common occurrence with amebic empyema (Fig. 4a). An hepatic abscess in the left lobe of the liver can be suspected if a roentgenogram of the abdomen following barium by mouth reveals the stomach to be displaced posteriorly and laterally. A widened pericardial shadow would indicate possible rupture into the pericardial sac.

#### PROGNOSIS

The prognosis of pleuropulmonary complications of an hepatic abscess due to the *Endamoeba histolytica* vary with the type of complication. The prognosis is much more severe if an empyema results. Ochsner and DeBakey (2) reported that in a collected series of empyema complicating hepatic abscesses the mortality was 77.7 per cent. In their own series the mortality was 66.6 per cent. The mortality was lower when a pulmonary abscess developed without the occurrence of an empyema. In this case it was 42.2 per cent in the collected series and 22.2 per cent in their series. The lowest mortality occurred when a bronchohepatic fistula developed without the occurrence of either empyema or pulmonary abscess. There was a mortality of 10 per cent in the collected series in this type of complication and no mortality in the series reported by Ochsner and DeBakey. This mortality was greatly reduced when emetine therapy was given. In the 153 patients in the collected series with pleuro-

pulmonary complications the mortality of 56.6 per cent when emetine was not used dropped to 9.1 per cent with emetine therapy. In the series reported by Ochsner and DeBakey (2) there was 60 per cent mortality without the use of emetine and no mortality when emetine was used. Ochsner and DeBakey (2) also further warned against unnecessary surgical drainage procedures in the case of hepatic abscesses and their pleuropulmonary complications. They showed that there was a 33 per cent mortality in the patients upon whom operations had been performed. They deserve much credit for pointing out the efficacy of emetine therapy in hepatic abscesses and their pleuropulmonary complications. With present techniques and with chemotherapy however surgery if necessary is safer than these authors indicate.

#### TREATMENT

Emetine is a specific drug for the hepatic abscess caused by the *Endamoeba histolytica*. Even after a pleuropulmonary complication has occurred, emetine should be used in an attempt to avoid surgery, and in conjunction with surgery should surgical interference become necessary. Emetine is a drug which must be used with extreme care because of its toxicity for cardiac muscle. Under ideal conditions an electrocardiogram should be made before treatment is instituted. A course of therapy should then be instituted once the diagnosis of an hepatic abscess has been established giving 1 grain doses intramuscularly daily for 6 to 10 days. Following this course of treatment the electrocardiographic tracings should be repeated to determine whether or not there has been myocardial damage. If the patient also has signs of amebic dysentery, such drugs as carbarone and diodoquin should be administered. It should be remembered however that this type of drug is toxic to the liver and should be used very cautiously if there are signs of extreme liver damage due to the abscess. In conjunction with the emetine therapy the abscess cavity within the liver should be aspirated if this is possible. If there is tenderness and bulging of the lower costal margin due to the presence of the abscess, aspiration with a long needle with an



Fig 4a



Fig 4b

Fig 4. Empyema secondary to rupture of amebic hepatic abscess into right pleura. a, Loculated empyema right. Large hepatic abscess has been drained subcostally and catheter drain can be seen in place. b Lateral view shows localized dome of diaphragm under anterior basal segment of right lower lobe. c, Empyema has cleared with drainage but fistula between hepatic abscess and bronchial tree remained causing repeated hemoptyses.

clans. At one hospital a diagnosis of carcinoma of the sigmoid colon had been made and resection of the colon was advised. The patient refused the operation and left the hospital against advice. The dysentery continued and he finally developed a severe pain in the anterior aspect of the lower right chest. He was admitted to a hospital and the abscess in the liver drained by the extracutaneous route. The patient was an adult male appearing chronically ill. There had been obvious weight loss. The physical examination was negative except for the region of the upper abdomen and lower right anterior chest. There was a transverse incision at the level of the 6th rib adjacent and lateral to its costal cartilage. Purulent material drained from this incision. Posterior-anterior and a right internal roentgen view of the chest showed a localized humping of the diaphragm anteriorly under the middle lobe (Fig 1). The middle lobe was shrunken in size and only partially air containing. The patient continued to run a low grade temperature elevation and there appeared a gradual extension of induration and inflammatory reaction about the incision on the chest.

On the 23rd of July the patient was returned to the operating room and the sinus tract was explored. At the bottom of the incision there was a small



Fig 4c.

tract which led into the pleura. For about 4 to 5 centimeters on either side of the incision there was obvious involvement of the chest wall with a meaty infection. With the cutting current of the endotherm a wide oval section of skin and subcutaneous tissue





Fig. 3a



Fig. 3c

tine therapy along with sulfadiazine was used early in the treatment of the infestation but surgery became finally necessary to bring about complete recovery.

#### POSTOPERATIVE MANAGEMENT

If emetine therapy had not been used previously either because a true diagnosis was not suspected or the urgency of the situation made it unwise to wait, it should be instituted



Fig. 3b

postoperatively with the safeguard of careful studies of the myocardium as outlined. Following the course of emetine therapy it is usually advisable to give a course of carbarsone or diodoquin for the dysentery. The use of this subsequent therapy will depend upon whether or not amebas can be demonstrated in the stools.

#### CASE REPORTS

**CASE 1.** C. T. H., aged 43 years, white male. This patient was admitted to Baylor University Hospital June 3, 1945 as a transfer from another hospital. At the former hospital an amebic abscess of the liver had been drained 2 weeks previously. At the time of the drainage of the abscess it had been found that the abscess had perforated the diaphragm into the right middle lobe. For 1 year previous to the original admission to this hospital the patient had complained of dysentery and had been seen by various phy-

\*Case was included in this report by the permission of Dr. Walton H. Cochran, his physician. This patient, although observed by the author, was not under his care.



Fig 4a



Fig 4b

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On the 28th of July the patient was returned to the operating room and the sinus tract was explored. At the bottom of the incision there was a small



Fig 4c.

tract which led into the pleura. For about 4 to 5 centimeters on either side of the incision there was obvious involvement of the chest wall with a meaty infection. With the cutting current of the endotherm a wide oval section of skin and subcutaneous tissue

including the right nipple was excised. The underlying muscles were relatively healthy. The old sinus was opened and the degenerated portion of the 6th rib along with a portion of the 5th rib were excised. This had bare a small cavity in the anterolateral and anterior portion of the right pleural cavity and a small abscess in the right middle lobe. The wound was packed with dry gauze. Pathological report showed amebiasis of the skin and subcutaneous tissue. Following the excision of the amebic abscess of the chest wall there was progressive healing and improvement and the whole wound finally healed without necessitating skin grafting. The patient has remained well.

**CASE 2.** H. P., aged 35 years, colored male. This patient was admitted to Parkland Hospital on November 9, 1947. He gave a history of epigastric distress after meals for 10 months. Two months before admission he developed a dry nonproductive cough worse in the evening and at night. Five weeks before admission he quit work because of weakness. Three weeks later he had an episode of coughing up of blood and rust-like sputum. He had lost 25 pounds in weight during the previous 5 weeks. There had been no pain in the chest. Two years before there had been a period of 2 months when the patient had frequent episodes of pain around the umbilicus and left abdomen. This pain was relieved by eating or by drinking milk. The patient stated that he had the bloody flux for several months.

Physical examination revealed a chronically ill colored male coughing frequently. The right chest was slightly sunken and lagged during respiration. There was dullness on percussion at the right base posteriorly and in the axilla. Breath sounds were depressed in the right posterior chest and a few coarse rales could be heard. The patient was noted to have marked pulmonary osteoarthropathy. Roentgenograms of the chest revealed a dense shadow in the base of the right lower lobe adjacent to the mediastinum (Fig. 2). There was a fluid level indicating pulmonary abscess. The remainder of the lung fields were clear. A bronchoscopy was performed on the 26th of November. The tracheal mucosa appeared normal. There was a considerable amount of mucopurulent secretion coming from the right lower lobe bronchi. This secretion was not foul. The diagnosis was nonpurulent abscess of the right lower lobe of lung.

On November 24 the right chest was opened following removal of the 7th rib. The pleural cavity was found to be free except where the lower lobe was densely adherent to the diaphragm. The structures at the hilum of the lower lobe were handled by dissection technique. The artery and vein were secured and severed. The bronchial stump was closed with individual sutures of No. 30 cotton. The dense adhesions to the diaphragm were then separated. In separating these adhesions the abscess in the base of the lung was broken into and it was found to have been caused by the eruption of an abscess in the liver through the diaphragm into the lower lobe. There was a large crater approximately 5 centimeters in

diameter and 2 centimeters in depth in the liver. The diaphragm was drawn together with mattress sutures of No. 30 cotton. A drain was placed in the 8th interspace in the posterior axillary line and connected to a water-seal bottle. The chest was closed. Pathological report was: Specimen consisted of right lower lobe of lung. In the base of the lobe surrounded by a large margin of normal appearing pleura there is a crater which is 7 by 6 centimeters in size and which extends up into the parenchyma of the lung for about 4 1/2 centimeters. This cavity is lined by very friable necrotic shaggy shreds of grey to reddish brown tissue and a small amount of thick purulent greyish green exudate is adherent to the wall. Communicating by an opening of 7 centimeter with the larger cavity is a smaller cavity 3.5 centimeters in diameter near the hilum. There is a smaller cavity of the same type of 3 centimeters in diameter near the base. The lung parenchyma is atelectatic and contains a small excess amount of blood. Microscopic examination of the sections of the lung reveals that the abscess wall shows the latter to contain on its surface a small amount of eosinophilic debris containing a moderate amount of polymorphonuclear neutrophilic leucocytes. Lying in this eosinophilic debris loosely attached to the lining of the abscess cavity are present numerous large round and slightly oval bodies which are sharply demarcated measuring 25 to 35 microns in size. These possess slightly eccentric nuclei which are quite small and hyperchromatic and contain a central nucleolus. The cytoplasm is distinctly eosinophilic, rather opaque in appearance and usually contains either intact or hemolyzed red blood cells and other debris. These bodies are entirely characteristic of the trophozoites of *Endamoeba histolytica*. Pathologic diagnosis was chronic amebic abscess of the lower lobe of the right lung. The diagnosis of amebiasis with amebic abscess of the liver rupturing into the right lower lobe was made at the time of surgery. The patient was immediately started on a course of emetine hydrochloride grains 1/4 three times a day. In addition the patient received postoperatively 50,000 units of penicillin every 3 hours until the 18th postoperative day. The patient was discharged on the 20th postoperative day. The patient's temperature which had been running consistently between 101 and 103 degrees preoperatively dropped rapidly to normal on the second postoperative day and remained normal until the time of discharge. The patient was discharged on the 20th postoperative day. He has remained well.

**CASE 3.** E. R., aged 3 years, colored male. This 33 year old colored male was admitted to Parkland Hospital on October 20, 1946. He gave a history of pain in the right chest for 6 months and swelling of the right breast for 1 week. One month before he had had a hemoptysis. This spitting up of blood had persisted for 3 weeks following which the cough was productive of thick sputum which was clear. The pain in the chest was a constant sharp nonradiating pain aggravated by cough and deep inspiration.

There had been swelling of the ankles with the present illness. He had lost 10 to 12 pounds in weight in the last 6 months. The patient thought that he had had a daily fever. The past history revealed that the patient had had diarrhea beginning about 11 years ago. This had continued with about 4 or 5 daily stools until 9 months ago. The stools had contained blood.

Physical examination revealed lagging of inspiration on the right side of the chest with decreased fremitus and dullness to percussion on the right both anteriorly and posteriorly. There were coarse moist rales at the right apex posteriorly. The breath sounds were diminished over the entire right chest below the second rib anteriorly and posteriorly. Examination of the sputum revealed *Endamoeba histolytica* cysts and trophozoites. Examination of the stools revealed cysts and *Endamoeba histolytica*.

The admission roentgenogram of the chest showed total obscuration of the right hemithorax. Subsequent to aspiration of the pleural fluid it could be seen that the loculated pleural fluid was chiefly in the lateral portion of the chest and that the base of the lung was adherent to the diaphragm over most of its surface (Fig. 3). On admission to the hospital the patient was given diodoquin 9½ grains three times a day and emetine 1 grain intramuscularly daily. Several thoracenteses were done with aspiration of fluid from the right chest. The fluid was slightly turbid thin and yellow in character. Examination of the fluid was negative for ameba.

On December 2, 1947 the right chest was opened through the 7th rib bed. A thick layer of fibrin was removed from the right lower and middle lobes. The anterior inferior segment of the right lower lobe which had been perforated by an abscess which came up through the diaphragm from the liver was excised. The diaphragm was closed without drainage. Pathological diagnosis was chronic, fibrinous and fibrous pleuritis, chronic fibroid pneumonia of lung. Following this operation the right lung expanded poorly so that on December 20 the chest was re-opened and a redecoration was done. Following this procedure the lung slowly re-expanded. The patient was discharged from the hospital on January 20, 1947.

The patient was followed in the surgical out patient clinic. On July 21 the patient was seen at which time he stated he was very well. He had no cough and his general condition was good. X-ray examination showed complete reabsorption of the fluid. Examination of the stools at this time was negative for ameba. The patient was advised to do full work.

CASE 4. F. R., aged 50 years, white, male. This patient developed a severe dysentery while working as a civilian employee with the army on the island of Guam. He was returned to the United States for further treatment. Upon admission to the Lisbon Veterans Administration Hospital he complained of severe pain in the right lower chest and cough and expectoration of bloody material. The patient was febrile. There had been a noticeable loss of weight.

Physical examination showed the patient to be an emaciated white male of about the stated age. There was dullness to percussion over the lower two-thirds of the right chest both anteriorly and posteriorly. There was tenderness around the lower right costal margin. There was some appearance of bulging of the right anterior chest in the inferior portion and a fullness in the right upper quadrant of the abdomen. Around this area the patient was tender to palpation. Examination of stools and sputum revealed the *Endamoeba histolytica*. X-ray examination of the chest (Fig. 4) revealed a loculated by dropneumothorax on the right. There was a localized elevation of the diaphragm best seen in the lateral film. This elevation of the diaphragm was in the anterior chest. The pulmonary tissue above this elevation appeared dense and atelectatic. In subsequent x-ray examinations a fluid level could be seen in this region. Turbid yellow fluid was aspirated from the right chest. This fluid was later found to be purulent so rib resection drainage was instituted. At a later date a subcostal anterior drainage of the large liver abscess was carried out by the extracutaneous route. The patient gradually improved. The lung slowly re-expanded. All drains were removed and the sinuses healed. The patient suddenly began to have hemoptyses which although not severe were annoying. It was evident due to bile in the sputum that there was a broncho-biliary fistula. A thoracotomy was advised for the purpose of breaking up this abnormal channel.

At operation on March 23, 1948 the right chest was opened through the 7th rib bed. The right pleural cavity was completely obliterated by adhesions which could be easily separated except around the previous drainage site and over the diaphragm. When the right lower lobe was separated from the diaphragm it was found that there was an opening through the diaphragm approximately a centimeter in diameter which led into a defect in the liver. The examining finger could be inserted through this opening into the hepatic cavity and counterdrainage was then secured through the previous drainage site through the anterior upper abdominal wall. A catheter was put in place and secured. The hole in the diaphragm was then closed. Examination of the indurated area in the base of the right lower lobe revealed a small abscess approximately a centimeter in diameter with a surrounding wall of infiltration. It was not thought necessary to remove this indurated area. Two mattress sutures were used to obliterate the small cavity. A drain was placed in the 10th interspace in the posterior axillary line and connected to a water-seal bottle. The chest was closed. The drainage tube was removed on the 2nd postoperative day since the lung was fully expanded. However on the 6th day it was evident that pleural fluid was reaccumulating. Aspiration yielded old blood indicating that there had been bleeding into the pleural space following removal of the intercostal drain. Drainage was reinstituted at the site of the original rib resection through the 9th rib. The patient gradually improved. The drains in the pleura

and hepatic abscesses were gradually shortened and eventually removed. The condition of the patient is now satisfactory. There have been no recurrences of the hemoptyses.

#### CONCLUSIONS

1. Hepatic abscesses are common complications of amebic dysentery. These abscesses are best treated by emetine therapy and should not be treated surgically unless certain indications are present.

2. Pleuropulmonary complications of hepatic abscesses can in the majority of patients be successfully treated with emetine therapy.

3. Surgery will be required if (1) the lung cannot be re-expanded (2) a bronchobiliary

fistula persists, (3) secondary infection occurs and (4) when damaged pulmonary tissue produces a continued morbid state.

4. Formal thoracotomies with removal of as much of the products of the infection as possible are preferable to drainage procedures.

5. Proper surgical intervention should further lower the mortality and morbidity in this disease.

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# CARCINOMA OF THE NASOPHARYNX

## Report of 150 Cases

MARVIN W. SIMMONS, M.D., McMinnville, Oregon and IRVING M. ARIEL, M.D., Minneapolis, Minnesota

CANCER of the nasopharynx is a highly malignant disease which has recently attracted the attention of pathologist and clinician. Usually the signs and symptoms of metastases from this growth have obscured the existence of the primary neoplasm accordingly adequate descriptions of the natural history of nasopharyngeal cancer have been delayed.

Prior to the beginning of the twentieth century very few references were found pertaining to this disease. Jackson in 1901 discussed only 13 cases in the world literature of which the earliest case report was in 1837. Not until 1921 was an adequate description of this type of cancer presented when Regaud and Reverchon and Schminke published papers independently describing the pathologic features. Trotter in 1911 had described the classical Trotter's triad resulting from nasopharyngeal neoplasms which consists of impaired hearing, neuralgia of the second branch of the trigeminal nerve and asymmetry of the soft palate.

Since 1921 excellent papers have been published including those of New 1922, 1925, 1931 and 1943, Lurstenberg 1938 and Martin 1940. This report presents the pathological and clinical features of an unselected consecutive group of 150 patients with nasopharyngeal cancer who were treated at the Veterans Administration Hospital, Illinois from 1931 to 1946 inclusive. The diagnosis in each instance was confirmed histologically.

From the Department of Otolaryngology, University of Illinois, College of Medicine and Veterans Administration Hospital, Illinois, Illinois.

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## ANATOMY OF THE NASOPHARYNX

A brief review of the normal anatomy will serve better to explain the morbid processes. The nasal part of the pharynx is an irregular cavity with six walls: anterior, posterior, two lateral walls, a floor and a roof. Anteriorly it communicates with the nasal cavities through the choanae or posterior nares. The floor is formed by the upper surface of the soft palate. Seldom does cancer originate from the anterior wall or the floor.

Posteriorly the wall slopes superiorly and anteriorly, blending into the roof or fornix which lies below the body of the sphenoid bone and is attached also to the basilar portion of the occipital bone. Its mucosa is thrown into multiple folds and contains much lymphoid tissue (adenoids).

The lateral walls contain the openings of the eustachian tubes. Behind the openings, the cartilage of the tube forms a prominent ridge, the torus. Superior and posterior to the torus is the pharyngeal recess or fossa of Rosenmueller and directly above the upper end of the fossa of Rosenmueller is the foramen lacerum affording entry into the intracranial cavity.

Histologically, pseudostratified ciliated columnar epithelium (respiratory epithelium) is seen to line the nasopharynx which changes into stratified squamous epithelium as one enters the oral part of the pharynx. There is an abundance of lymphoid tissue. Goblet cells and mixed glands of serous and mucous cells are present also.

**Lymphatics.** Because tumors of the nasopharynx produce early and extensive cervical metastases, a knowledge of the lymphatics of this region is of paramount importance. Lymphatic drainage of the nasopharynx is mainly into nodes in the retropharyngeal area and into nodes along the superior portion of the

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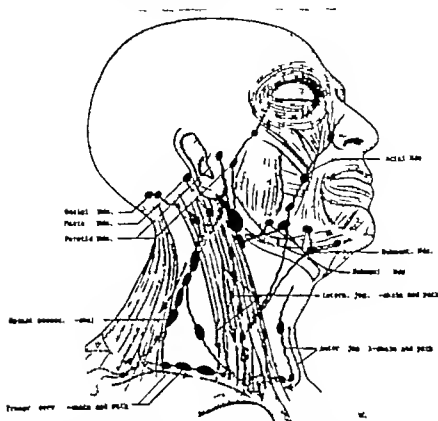


Fig. Schematic representation of the lymphatic drainage and nodal connections of the face and neck. (After Rouvière.)

internal jugular vein (13) The collecting lymphatic trunks are very numerous and originate from the pharyngeal tonsil the roof posterior wall and lateral walls around the eustachian orifices. These combine and traverse the pharyngeal walls and usually terminate in the lateral retropharyngeal nodes however some terminate in nodes of the upper internal jugular chain. Some also may end in nodes further inferior or extend posteriorly and end in nodes along the spinal accessory nerve. Efferent channels from these nodes terminate in supraclavicular nodes. Hence, it can be seen why metastases from cancer of the nasopharynx may appear anywhere in the cervical region (Figs. 1 and 2)

#### INCIDENCE

During the 16 year period from 1931 to 1946 inclusive, there were 19 976 patients with primary malignant tumors admitted to Vet

erans Administration Hospital Hines, Illinois. Of this group 1,299 neoplasms were found involving the upper digestive and respiratory tract (exclusive of hp) Intra-oral carcinoma thus comprised 6.3 per cent of all malignant neoplasms. Carcinoma of the nasopharynx represented 11.5 per cent of all intraoral cancer and 0.7 per cent of all patients admitted to this hospital bearing malignant tumors. Martin (8) observed that cancer of the nasopharynx represented 2 per cent of all malignant growths at Memorial Hospital

#### ETIOLOGY

Age An accurate picture of the true age and sex incidence of nasopharyngeal carcinoma cannot be obtained from the records of a veterans hospital because of the select group of patients admitted. The average age of this series was 45 years the youngest patient was 19 years and the oldest was 68 years. In 32

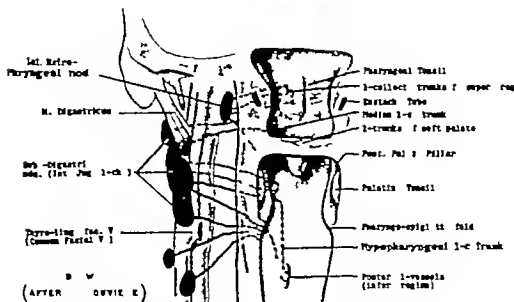


Fig. 2 Schematic representation of the lymphatics of the pharynx and their nodal connections. (After Rouvière.)

patients (21.3%) the age was below 40 years. Only 5 patients (3.3%) were over 60 years old. Because this disease occurs in patients who are relatively young the need for considering cancer of the nasopharynx in younger age groups is emphasized. Cancer of the nasopharynx occurs in children and in adults below 30 years more often than any other malignant growth of the upper respiratory and alimentary tracts (8).

**Sex.** The sex was exclusively male in this series. Other authors describe a marked predilection (80%) in the male sex for this disease entity (8, 9).

**Race.** In this group 88 per cent of the patients were white and 11.3 per cent were negro. The percentage of negro patients hospitalized at this institution for all causes is 15 per cent. Therefore the percentage of colored patients who had cancer of the nasopharynx does not differ significantly from the overall admission rate of negroes. One patient was Chinese, an incidence of 0.6 per cent of the entire group. Certain authors have described a high preponderance of nasopharyngeal carcinoma among the Chinese. Because of the select group of patients admitted at a Veterans Hospital for therapy, one would not expect a high admission rate of Chinese individuals.

**Other factors.** In the quest for certain factors which might have significance etiologi-

cally, analysis in this series was made of alcohol intake, smoking, and syphilis.

From our study one cannot say that either tobacco or alcohol contributes toward the production of cancer of the nasopharynx. A study of the incidence of syphilis revealed that 11 (7.3%) of the entire group had syphilis. No significance is attached to syphilis as an etiological factor since 5 per cent of all patients admitted to the hospital have positive Wassermann reactions.

A study to ascertain whether chronic infections, tonsillitis, or other infective or metabolic abnormalities contributed to the production of nasopharyngeal malignant neoplasms was found to yield negative results.

#### PATHOLOGY

**Gross pathology.** Nasopharyngeal carcinoma usually manifests itself early as a slight bulge or ulceration. It may originate in the irregular folds of persistent lymphoid tissue frequently present in the nasopharynx, usually in the fossa of Rosenmueller. This tiny lesion is frequently the source of massive cervical metastases. Not infrequently no demonstrable lesion is present and from 1 month to 2 years may elapse before the lesion becomes manifest.

As the tumor grows it may fill completely the nasopharynx with a bulky, fungating, friable mass or the lesion may be infiltrative and ulcerating.



Fig. Schematic representation of the lymphatic drainage and nodal connections of the face and neck. (After Rouvière.)

internal jugular vein (13) The collecting lymphatic trunks are very numerous and originate from the pharyngeal tonsil the roof posterior wall and lateral walls around the eustachian orifices. These combine and traverse the pharyngeal walls and usually terminate in the lateral retropharyngeal nodes however some terminate in nodes of the upper internal jugular chain Some also may end in nodes further inferior or extend posteriorly and end in nodes along the spinal accessory nerve Efferent channels from these nodes terminate in supraclavicular nodes. Hence, it can be seen why metastases from cancer of the nasopharynx may appear anywhere in the cervical region (Figs. 1 and 2)

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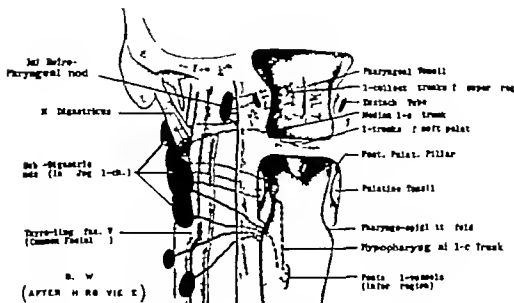


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As the tumor grows it may fill completely the nasopharynx with a bulky fungating friable mass or the lesion may be infiltrative and ulcerating.



Fig. 3. Extension of nasopharyngeal carcinoma along base of brain with displacement of intracranial structures.

**Location.** Twenty-six patients (17.3%) of the 150 cases presented lesions in Rosenmueller's fossa. The next most frequent site was the posterior pharyngeal wall which was noted in 18 patients (12%) of which 6 (4%) were in the midline. The pharyngeal tonsil was the probable site of origin of the group that presented posterior pharyngeal wall lesions. The lateral wall (other than Rosenmueller's fossa) was the initial seat of the carcinoma in 10 patients (6.7%). A bulky cauliflower type of lesion filling the entire nasopharynx was described in 10 patients upon admission. Nine patients (6%) presented their initial lesion on the vault or roof. In 59 patients (40%) the exact location of origin could not be ascertained. This series, therefore, indicates that the most common site of origin of nasopharyngeal carcinoma is the lateral wall including the fossa of Rosenmueller.

The side involved was noted in all but 12 patients. In 42 cases (28%) the right side was involved in 39 cases the left side. In 57 patients (38%) both sides were involved.

**Histology.** Considerable controversy exists concerning the pathogenesis and nosology of

neoplasms arising from the nasopharynx (8, 12, 14, 15). We have adopted Stewart's classification (8).

In this series, epidermoid carcinoma comprised 34.7 per cent and transitional cell carcinoma 30.7 per cent. Anaplastic carcinoma was observed in 14 patients (9.3%) and in 8 instances (5.3%) the neoplasm was unclassified. Although certain anaplastic and unclassified neoplasms resembled lymphosarcoma it was felt that sufficient criteria were not present to warrant that histologic classification. During the same period 5 nasopharyngeal fibromas, 2 plasmocytomas and 2 adenocarcinomas of salivary gland origin were observed.

#### INTRACRANIAL EXTENSION

Extension of the tumor extradurally into the intracranial cavity frequently causes a host of neurologic symptoms duplicated by few other disease entities. In 2 cases in this series all cranial nerves were affected. The proximity of the foramen lacerum to the superior lateral wall of the nasopharynx affords an easy path for the cells to ascend and extend beneath the dura, stripping it from the base of the skull. In no case in our series was invasion of the dura observed.

Bone erosion may occur from pressure of the tumor or because of stripping of its nutrient periosteum from the bone by the spreading cancer. This was observed in 6 postmortem examinations in this series. The cranial nerves are affected usually by pressure and not by actual invasion (Fig. 3).

As the neoplasm extends forward the inferior orbital fissure may be invaded producing proptosis and pressure on the optic nerve may produce blindness. Only in terminal stages is papilledema or other evidence of increased intracranial pressure observed.

The brain was damaged apparently due to pressure in 6 cases. Of this group two had softening of the frontal lobe the cause, seemingly, of personality changes not infrequently noted in victims of this type of cancer.

Upon admission 44 patients (29.3%) had involvement of one or more cranial nerves. After admission 11 additional patients (7.3%) developed the symptoms of cranial nerve involvement. Freedom of any cranial nerve



Fig. 4. Unilateral metastatic upper cervical nodes from a nasopharyngeal carcinoma.



Fig. 5. Voluminous bilateral metastases to cervical nodes from nasopharyngeal carcinoma.

involvement was noted in 95 patients (63.3%).

The abducens nerve was the one most frequently involved (24%) because of its location over the foramen lacerum. The second most commonly involved nerve was the hypoglossal as observed in 28 patients (18.6%) due usually to compression of the nerve as it emerges from the skull through the hypoglossal canal.

The trigeminal nerve was the third most commonly affected cranial nerve as noted in 26 cases (17.3%). Next in order were the vagus and glossopharyngeal nerves with 24 cases (16%) and 23 cases (15.3%) respectively. These nerves were compressed usually as they emerged through the jugular foramen by cervical metastases rather than extension of the tumor within the skull. The oculomotor nerve was sixth in order with 18 patients (12%) demonstrating ophthalmoplegia. The seventh and eighth nerves are well protected within the internal auditory canal of the petrous temporal bone but when the facial nerve exits through the stylomastoid foramen it may be compressed by enlarged lymph nodes. Seventeen instances of facial paralysis were noted (11.3%). Only 4 patients had auditory nerve findings (2.6%). The optic nerve tract was affected in 7 patients (4.6%). Only 2 in

stances of involvement of the olfactory nerve were noted. The tumor was very extensive in each case and all of the 12 cranial nerves were involved. A Horner's syndrome was observed in 26 instances (17.3%).

#### CERVICAL METASTASES

Upon admission 125 patients (83.3%) presented cervical metastases. In an additional 5 patients (3.3%) metastases developed after admission. Thus 86.6% of all patients developed cervical metastases and in only 20 patients (13.3%) were no cervical metastases observed. In 67 of the cases (44.7%) bilateral neck metastases developed.

Any of the cervical chains may be involved and not infrequently all chains are invaded. The upper deep cervical lymph nodes were most frequently involved in this series (Figs. 1 and 2) and submental and submaxillary node involvements were only infrequently encountered.

**Generalized metastases.** Of the 37 autopsies obtained from 128 deaths there were 9 (24.3%) who had extension to the intracranial cavity. Of this number 4 patients did not have cervical metastases. Intracranial extension may

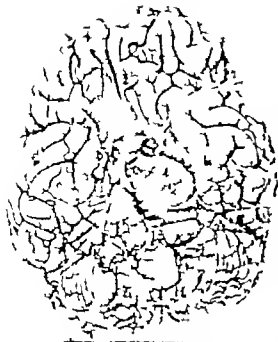


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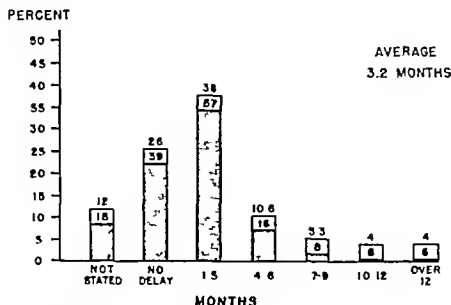


Chart 1 Time Interval from date of symptoms to date of first seeking medical attention.

Involvement of several cranial nerves may produce a Gradenigo syndrome (1) or Trotter's triad. When metastases to cervical lymph nodes are marked or lateral extension occurs the jugular foramen syndrome is found as the ninth, tenth, eleventh and twelfth nerves and the cervical sympathetics are paralyzed. One observes weakness and asymmetry of the soft palate with loss of the gag reflex. Loss of taste on the posterior third of the tongue is present and the patient complains of dysphagia and accumulation of secretions in his pharynx. Passage of food into the lower respiratory tract occurs with consequent cough. Hoarseness may be noted due to paralysis of one vocal cord.

#### DIAGNOSIS

The disease is protean in its manifestations and may imitate many other neurological, otolaryngological and ophthalmological conditions. Description of nasopharyngeal cancers can be found in journals relating to the nervous system (4 of 18), the ear, nose and throat (8), the eye (2), as well as in journals of pathology (16), radiology (7) and general surgery (1). Early the symptoms are referable to areas other than the nasopharynx and accordingly the diagnosis is missed frequently. In this series the correct diagnosis was not suspected by the referring physician in 92 patients (61.3%). The following diagnoses were the ones erroneously made by referring

physicians: inflammatory lesions 28 patients, cervical Hodgkin's disease 20 patients, primary cervical carcinoma 8 patients, cerebellopontine angle tumor 1 patient.

Other diagnoses included organic brain disease, central nervous system lesions, neck abscess, otitis media and chronic sinusitis.

Previous to admission 21 operative procedures had been performed on 19 (12.7%) patients in this series in the presence of the un-



Fig. 7. Horner's syndrome and deviation of tongue to side of lesion (twelfth nerve) in a patient with a nasopharyngeal carcinoma. Note smaller pupil and ptosis of upper lid, right eye.



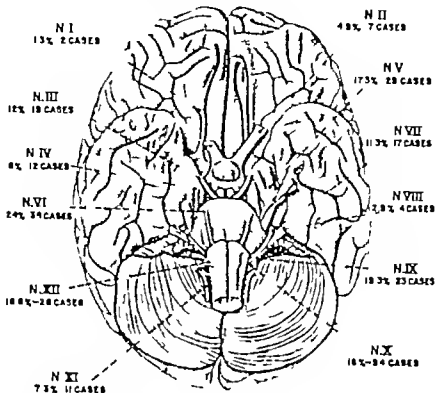


Fig. 6. Base of the brain (b) cranial nerves showing incidence of each cranial nerve involvement. (Courtesy, Blakiston Co.)

occur without cervical metastases. Twenty patients (54%) had generalized metastases. The liver (15 cases) and lungs (9 cases) were the most frequent visceral organs involved.

Generalized metastases occur more frequently from nasopharyngeal carcinoma than from any other intraoral cancer. It was observed in only 13.9 per cent of 72 autopsies on patients with carcinoma of the tongue at this hospital (unpublished data).

#### SYMPTOMS AND CLINICAL COURSE

**Initial symptom:** Nasopharyngeal carcinoma develops insidiously and rarely presents initial symptoms due to the primary growth. Symptoms from cervical metastases and intracranial extension usually focus attention upon the existence of the neoplasm. In this series of 150 patients it was noted that the most frequent symptom was swelling of the neck observed in 73 instances (48.7%). Pain of the side of the face and head was the initial symp-

tom in 19 instances (12.6%). In only 6 patients (4%) was nasal obstruction a presenting symptom with an additional 3 patients (2%) who had associated deafness and epistaxis.

The ear was involved in 11 patients of this group (7.3%) who had a presenting complaint of earache, deafness, and tinnitus. In 7 patients (4.7%) the first symptom noted was referable to the eye and patients complained of poor vision, pain or diplopia. In an additional 4.7 per cent of the entire group various miscellaneous symptoms were present including loss of weight, paralysis of the lower legs due to spinal cord metastases, and difficulty in talking.

**Physical signs:** In addition to bulky cervical metastases, the physical signs usually result from pressure of the tumor upon contiguous structures. Conduction deafness was observed in 48.6 per cent of all patients. Signs referable to cranial nerve involvement were observed in 36.7 per cent of all cases.

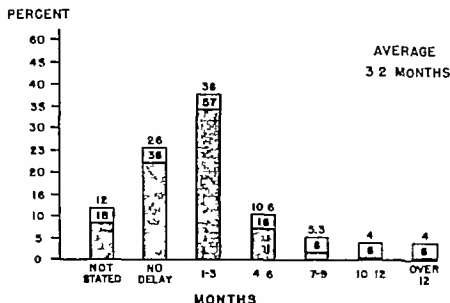


Chart Time interval from date of symptoms to date of first seeking medical attention.

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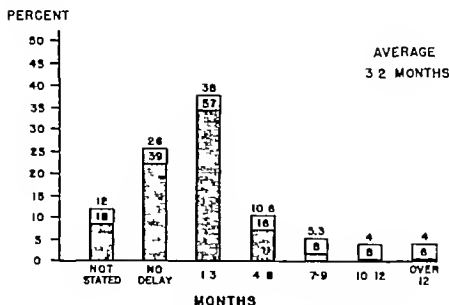


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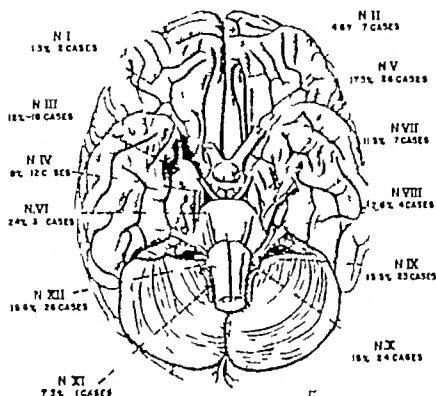


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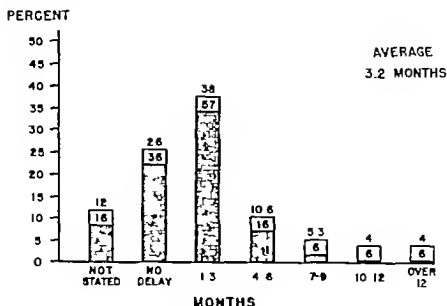


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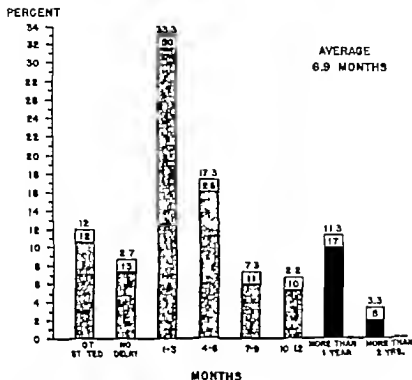


Chart 2. Period of delay of doctor to make diagnosis.

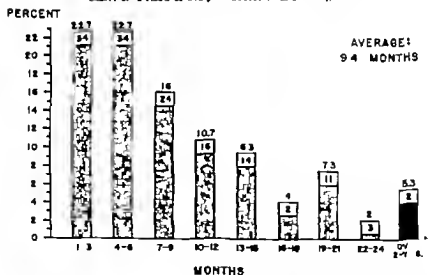


Chart 3. Time interval from date of onset of symptoms to date of correct diagnosis in 50 cases.

suspected nasopharyngeal carcinoma. There were 7 tonsillectomies, 3 mastoidectomies, 3 multiple teeth extraction, 2 instances of incision and drainage of neck abscesses, 4 intra-nasal polypectomies, 1 radical sinus resection and 1 paracentesis of the ear drum.

#### DELAY IN DIAGNOSIS

In 39 cases (26%) the patient sought medical attention within 1 month after onset of symptoms. In Chart 1 this group of patients is considered as showing no delay in seeking medical attention. The average lapse of time



Fig. 8. Irradiated skin reaction demonstrating location of lateral facial portals.



Fig. 9. Irradiated skin reaction demonstrating location of infraorbital portals.

before the patient applied for medical care was 3.2 months. Twenty patients (13%) delayed over 6 months.

After the first visit to the physician an average lapse of 6.9 months occurred before the correct diagnosis was made by the doctor (Chart 2). In 13 patients (8.7%) the diagnosis was made within the first month this was considered as no delay. In 22 patients (14.6%) more than 1 year was required by the physician to make a correct diagnosis.

Chart 3 demonstrates that the average time interval from the onset of symptoms until the correct diagnosis was established was 9.4 months. In 42 patients (28%) the diagnosis was made after a lapse of 1 year following onset of the first symptom. In only 34 patients or 22.7 per cent was there a delay of less than 3 months.

#### DIFFERENTIAL DIAGNOSIS

Cancer is the most frequent lesion of the nasopharynx in the adult. A careful examination of the nasopharynx using a soft palate retractor and a curved mirror aided by finger palpation will permit the taking of a biopsy of any suspicious area. It is emphasized again that the lesion may be small and covered frequently by hypertrophied lymphoid tissue. Accordingly any irregularity or firmness warrants a deep bite with the biopsy forceps.

All children and young adults who have undergone resection of *adenoids* should be examined for possible neoplasia.

Nasopharyngeal fibroma found in adolescent males involute as maturity is reached. These tumors are characterized by a smooth surface and very profuse bleeding. Other tumors which have been described in this location are salivary gland tumors, chordomas from the primitive notochord, cranio-pharyngealomas from Rathke's pouch and plasmocytomas. To a less extent are found teratomas of the epipharynx, hemangiomas, lymphangiomas, choanal polyps and retropharyngeal lymph node tuberculosis.

Rarely does a tumor of the pituitary gland extend into the postnasal space. The differential diagnosis here is particularly important to avoid a possible craniotomy.

In all metastatic cervical neoplasms in which no primary lesion has been discovered careful scrutiny of the nasopharynx should be performed repeatedly. Nasopharyngeal carcinoma is one of the most frequent lesions which remains quiescent but produces early metastases.

Neurological symptoms occur early and frequently and should invite a careful examination of the nasopharynx.

Frequently the patient is not carefully studied and is referred for neurosurgical intervention. Concerning this feature Davis and Martin state:

We believe it is usually evidence of carelessness on the part of some examiner at





Fig. a and b, Nasopharyngeal carcinoma. With intracranial extension and bilateral abducens nerve paresis before intensive irradiation. Portals for treatment are outlined.



Fig. a, b, and c, Disappearance of abducens nerve paresis following irradiation. Not skin changes from deep x-ray treatment. Same patient as shown in Figure 10, a and b.

some time during the course of the patient's history if the patient arrives in the hands of the neurologic surgeon with signs of intra-

cranial extension from a nasopharyngeal tumor which is only then recognized for the first time

PERCENT

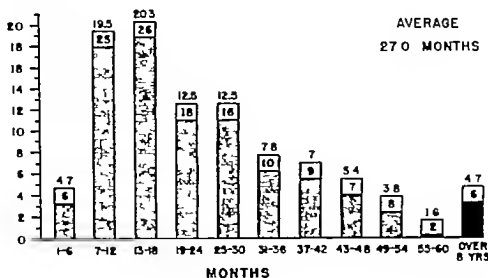


Chart 4. Time interval from date of onset of symptoms to date of death in 128 deaths.

Roentgenograms have not been of significant aid in establishing the diagnoses and radiological evidence of bone destruction was noted in 6 cases of this series.

A biopsy should be taken always of any suspicious area to establish the diagnosis.

#### TREATMENT

Therapy of cancer of the nasopharynx is exclusively irradiation and all patients in this series were so treated. The early metastases, the anatomical inaccessibility and the undifferentiated features of the disease obviate success with surgery.

The patient's general condition during roentgen therapy must receive paramount consideration and maintenance on an adequate caloric intake supplemented with vitamins is essential. An oral hygienist should administer local hygienic measures before and during therapy.

*Treatment of the primary lesion.* Fractionated x radiation is recommended. The following factors are now utilized: 200 to 250 kilovolts, 50 to 60 centimeters target skin distance, a filter of 0.05 to 1 millimeter of copper and 4 to 6 milliamperes. The field size varies from 6 to 8 centimeters in diameter. The ports used are two lateral fields which may be combined with anterior infraorbital fields. A dosage of 700 r to each of two ports daily is given until about 3500 r; times two have been

administered. Supplemental therapy may include an additional 1000 milligram hours with the Martin Blady nasopharyngeal radium applicator (8) (Figs 8 and 9).

*Treatment of the metastases from nasopharyngeal cancer.* Patients that have metastases high in the neck may be treated through a portal which will include both the primary neoplasm and the cervical metastases. In most instances, too large a portal would be necessary, so it is better to treat the primary as a separate entity and utilize a separate port for the cervical metastases. Externally applied deep x radiation therapy is preferred for the metastases. We believe with Martin (8) that it is advisable to limit the size of the port and treat only the visible metastatic lesions instead of using large ports which will cover the entire cervical area. A dose of 4000 to 5000 r measured in air may be administered. At the completion of this dose if any of the disease persists radon seeds (5 to 8 threshold skin erythemas) may be administered interstitially.

Following the first treatments of radiotherapy a rapid diminution of the severity of the symptoms occurs and cranial nerve paralyses may entirely disappear (Figs 10 and 11). Distant metastases should be treated with deep roentgen therapy and the dose determined by the symptomatic response. Small doses (750 to 1000 r) may frequently produce marked improvement.

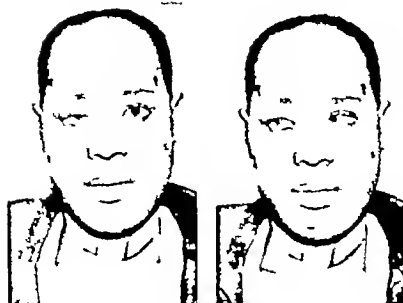


Fig. 1. a. Normal appearance. b. After treatment with 100 mg. of prednisone daily for 10 days.



Fig. 2. c. Normal appearance. d. After treatment with 100 mg. of prednisone daily for 10 days. e. After treatment with 100 mg. of prednisone daily for 10 days.

some time in the course of the patient's illness if the patient arrives in the hands of the physician with a normal intra-

cranial extension from a nasopharyngeal tumor which is only then recognized for the first time.



Fig. 1. M. C. 35484. Adenoma of parotid gland. Eosin and methylene blue stain.  $\times 162$



Fig. 2. F. L. 30087. Hemangioma of parotid gland. Phosphotungstic acid and hematoxylin stain.  $\times 70$

the carotid artery. The mass was dissected free and removed together with the submaxillary gland.

The surgical specimen was an irregular firm mass 2 by 3 by 3.5 centimeters. It was made up of dark red tissue with a firm pinkish-tan mass representing the submaxillary gland at one end. Histologic sections showed a plexiform mass of capillary blood vessels in the salivary gland and surrounding tissues. The diagnosis was hemangioma (Fig. 3).

**CASE 5.** R. E., a 26 year old white male, had noted a swelling at the angle of the left side of the jaw since childhood. It had varied in size, was occasionally tender and sensitive. Lately it had so increased in size as to interfere with shaving. Examination showed a soft mass 6.5 centimeters in diameter. At operation a multilocular dark gray cyst was found lying beneath the platysma muscle on the left side and closely attached to the submaxillary gland.

The surgical specimen measured 4 by 4 by 3.8 centimeters. A partially collapsed multiloculated cystic mass was attached to a fragment of normal salivary gland. Microscopic examination showed in addition to normal salivary gland several small cysts with thin fibrous endothelium-lined walls.

Diagnosis was cavernous lymphangioma (Fig. 4).

**CASE 6.** A. J. G., a 40 year old white male, noted a small painless swelling in the right side of the neck under the jaw, progressively enlarging for 6 months before hospital admission. On physical examination there was a discrete nontender resilient tumor the size of a walnut in the right submaxillary region. An x-ray film showed no opacity. At operation the mass was found to be encapsulated, firmly adherent to the submaxillary gland at its inferior margin. It was easily shelled out when the capsule was incised.

The surgical specimen was ovoid lobulated encapsulated firm and yellowish brown. It measured 4 by 3.5 by 2.5 centimeters. On section the cut surfaces bulged and had a translucent cast with foci of hemorrhage in a yellowish-gray parenchyma. Microscopic study showed a compact mass of elongated smooth muscle fibers either lying in a parallel arrangement or forming an interwoven matrix. The nuclei were ovoid and plump without any evidence of increased cellular activity. There were fairly abundant fibrous strands and collagen. Special stains revealed most of the elements in the new growth to be of smooth muscle origin. The diagnosis was leiomyoma of submaxillary gland (Fig. 5).



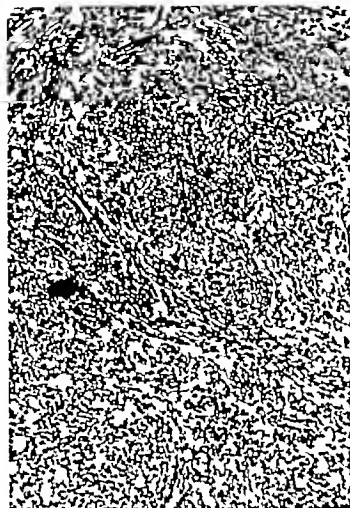


Fig 5 A J G S-49-530 Leiomyoma of parotid gland. Phosphotungstic acid and hematoxylin stain.  $\times 165$

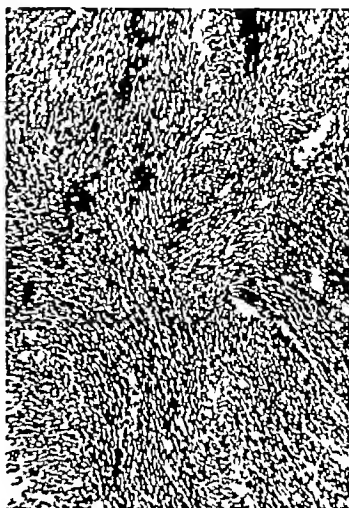


Fig 6 T W 31399. Perineurial fibroma of parotid gland. Hematoxylin and eosin stain.  $\times 190$ .

ear for 3 years. This was a moderately soft, non tender, slightly movable mass,  $1\frac{1}{4}$  inches in diameter. The cystic tumor located in the superficial portion of the left parotid gland was surgically excised. A small amount of yellow purulent appearing fluid escaped when the cyst was broken in one place during removal.

Pathological examination showed a soft fleshy encapsulated cyst containing friable pink tissue. Microscopically the tumor was similar to that in Case 8. The diagnosis was papillary adenocystoma lymphomatousum (Fig 7).

CASE 10: A J S a 45 year old white woman was first seen November 9, 1933 because of a gradually enlarging mass on the right side of the face which was first noted following the extraction of a molar tooth 6 weeks previously. On examination the right parotid gland presented a rounded tumor just below the zygomatic arch and anterior to the auditory canal. The tumor was the size of a walnut. Intraorally there was a tense round firm bulging tumor on the medial aspect of the ascending ramus of the mandible. The clinical diagnosis was mixed tumor of the parotid gland. This was later changed to carcinoma simplex on the basis of an aspiration

biopsy. Despite temporary remission as a result of radiation therapy the patient died on July 19, 1938. At this time the local neoplasm had ulcerated and there was invasion of the right naris.

At autopsy the soft friable, reddish gray tumor was found to have penetrated the bones of the base of the skull and extended to the right temporal lobe of the brain. It had eroded the right orbit posteriorly, the right maxillary sinus and zygomatic arch, and it had destroyed the ethmoid bone and sella turcica. The origin was still thought to be the right parotid gland.

Cytologically the neoplasm consisted of closely packed, elongated cells focally arranged and isolated by necrotic tissue. The cells blended with each other had plump oval nuclei, and were assembled in interlocking fascicles. Many bizarre nuclear forms and asymmetrical mitoses were seen. No cross striations were found but the malignant cells took the usual stains for muscle. The final diagnosis was leiomyosarcoma of the parotid gland (Fig 8).

CASE 11: W B a 60 year old, white male had noted a painless gradually enlarging mass in front of the right ear for 8 months. A smaller nodule was present in the neck. Examination showed a hard



Fig. 1. K. E. 0005. Hemangioma of submandibular gland. Hematoxylin and eosin stain, X40.

CASE 7. T. W., a 14 year old white boy was seen because of a painless slowly growing tumor in front of the left ear of 6 years duration. The mass was firm, smooth slightly tender and fixed. It was about 3.5 centimeters in diameter. The preoperative diagnosis was mixed tumor of the parotid gland. It was operated upon with removal of a necrotic, dark brown tumor.

The mass weighed approximately 4 grams. In it there were many areas of soft to firm pale gray to dark red tissue. Histologically the tissue was made up of compactly arranged, elongated cells of uniform size and shape and tall ung reaction. These cells had clear lusciform nuclei. It was impossible to make out the ends of the fibers. This neoplastic tissue formed its own trophic. Many loci of calcification and localized hemorrhages were found. The diagnosis was perineurial fibroma (Fig. 6).

CASE 8. C. F. N., a 69 year old physician was first seen on July 30, 1930 with a painless swelling in the left parotid region of 15 months duration. At operation surgical removal of a well encapsulated roughly ovoid tumor 3 by 2 by 3 centimeters was done. This tumor proved microscopically to be a papillary adenocystoma lymphomatousum. One and



Fig. 2. R. L. 5006. Cavernous lymphangioma of submandibular gland. Lössin and methylene blue stain, X45.

half years later he was readmitted to the hospital with similar swelling in the right parotid gland of 3 months duration. Excision of this tissue revealed a spherical cystic mass 3 centimeters in diameter which shelled out of the right parotid gland. During removal it ruptured and mucinous material escaped.

The surgical specimen contained salivary gland in addition to a soft reddish-gray mass measuring 3.2 centimeters in diameter. Section showed a firm, bulging, homogeneous pale red and gray surface with fleck of sticky mucin. Microscopic study showed portions of normal parotid gland. The rest of the specimen was made up of thick papillary projections composed of dense lymphoid tissue surmounted by ciliated mucin laden tall columnar epithelium. This tumor was similar to that removed from the left parotid region a year and a half previously. Diagnosis was giant papillary adenocystoma lymphomatousum.

Before the operation on the left side the clinical diagnosis was mixed tumor of the parotid gland. However before the one on the right, the tumor was suspected to be similar to the former one.

CASE 9. M. F., a 72 year old white male had noticed slowly enlarging lump in front of the left

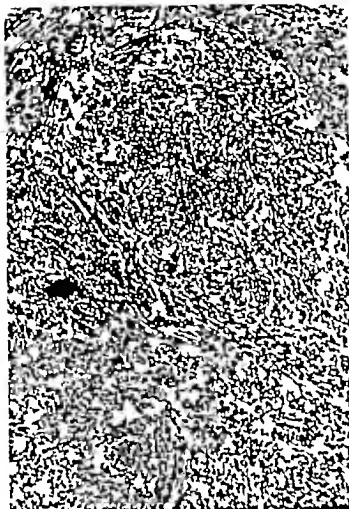


Fig. 5 A. J. G. S. 40-530. Leiomyoma of parotid gland. Phosphotungstic acid and hematoxylin stain,  $\times 162$ .

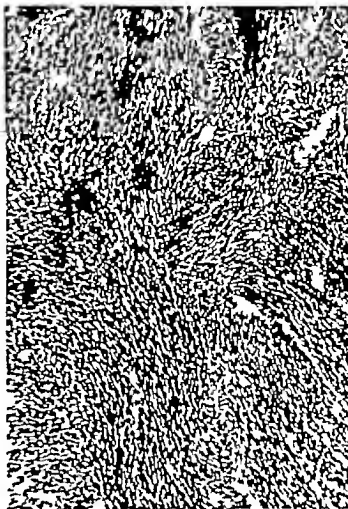


Fig. 6 T. W. 31399. Perineurial fibroma of parotid gland. Hematoxylin and eosin stain,  $\times 120$ .

ear for 3 years. This was a moderately soft, non-tender, slightly movable mass  $1\frac{3}{4}$  inches in diameter. The cystic tumor located in the superficial portion of the left parotid gland, was surgically excised. A small amount of yellow purulent appearing fluid escaped when the cyst was broken in one place during removal.

Pathological examination showed a soft, fleshy encapsulated cyst containing friable pink tissue. Microscopically the tumor was similar to that in Case 8. The diagnosis was papillary adenocystoma lymphomatousum (Fig. 7).

CASE 10. A. J. S. a 45 year old white woman was first seen November 9, 1933 because of a gradually enlarging mass on the right side of the face which was first noted following the extraction of a molar tooth 6 weeks previously. On examination the right parotid gland presented a rounded tumor just below the zygomatic arch and anterior to the auditory canal. The tumor was the size of a walnut. Intraorally there was a tense round firm bulging tumor on the medial aspect of the ascending ramus of the mandible. The clinical diagnosis was mixed tumor of the parotid gland. This was later changed to carcinoma simplex on the basis of an aspiration

biopsy. Despite temporary remission as a result of radiation therapy the patient died on July 19, 1938. At this time the local neoplasm had ulcerated and there was invasion of the right naris.

At autopsy the soft, friable, reddish gray tumor was found to have penetrated the bones of the base of the skull and extended to the right temporal lobe of the brain. It had eroded the right orbit posteriorly, the right maxillary sinus and zygomatic arch, and it had destroyed the ethmoid bone and sella turcica. The origin was still thought to be the right parotid gland.

Cytologically the neoplasm consisted of closely packed elongated cells focally arranged and isolated by necrotic tissue. The cells blended with each other had plump oval nuclei, and were assembled in interlocking fascicles. Many bizarre nuclear forms and asymmetrical mitoses were seen. No cross striations were found but the malignant cells took the usual stains for muscle. The final diagnosis was leiomyosarcoma of the parotid gland (Fig. 8).

CASE 11. W. B. a 60 year old, white male had noted a painless gradually enlarging mass in front of the right ear for 8 months. A smaller nodule was present in the neck. Examination showed a hard





Fig 7 M. F. 15000. Papillary adenocystoma lymphomatous. Hematoxylin and eosin stain,  $\times 7$ .

ovoid slightly movable tumor 3 by 3 by 3 centimeters in the region of the right parotid gland and a smaller roughly spherical mass 1.5 centimeters in diameter lying beneath it. Although the primary choice was parotid tumor a clinical diagnosis of lymphoma was considered because of the enlarged node in the left side of the neck and a palpable node in the groin. At operation two tumors were excised from the right parotid gland. The larger measured 3 by 4 by 3 centimeters, and occupied the middle and upper portions of the gland; the smaller was in the lower half of the gland and measured 1.5 by 1.5 by 1 centimeters. There was no definite plane of cleavage.

Examination of the specimens showed normal salivary gland incorporating firm pale gray rubbery well vascularized, homogeneous tumor tissue. Histologic study showed some residual parotid gland but the significant change was the extensive replacement by mature and immature lymphoid elements. The widespread invasion by young and old lymphocytes with many cells in mitosis indicated a diagnosis of lymphosarcoma (Fig. 9).

CASE 1. O. H. a 68 year old white woman was first seen because of a mass at the right angle of the



Fig 8 A. J. S., 35-A-8. Leiomyosarcoma of parotid gland. Phosphotungstic acid and hematoxylin stain,  $\times 475$ .

jaw closely attached to the lower portion of the parotid gland. It had been painful on occasions. The mass was first noted 3 months previously after recovery from a respiratory infection. Physical examination revealed a fixed, nontender oval mass, 1.5 by 9 by 8 centimeters lying beneath the angle of the jaw on the right side. Intraoral examination was negative. A clinical diagnosis of lymphoma or metastatic tumor was made. Biopsy was performed. At operation the new growth lay within the right parotid gland and there was no obvious line of demarcation. Gross and microscopic study substantiated the clinical impression of lymphoma. The final diagnosis was malignant lymphocytoma. No evidence of recurrence following radiation therapy was reported in a follow up examination 3 years later.

CASE 13. C. B. a 51 year old white woman, was seen because of a tumor near the angle of the right side of the jaw which had been present for 3 months and had recently been increasing in size. On examination the mass was fixed to the tissues, lay in or near the submandibular gland and was described as being the size of a "hen's egg." Some enlarged cervical nodes were found in the supraclavicular



Fig. 9. Lymphosarcoma of parotid gland. Eosin and methylene blue stain, X90.

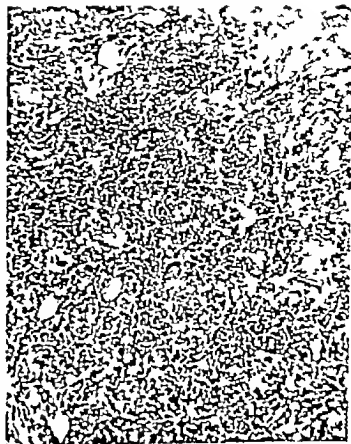


Fig. 10. C. B., 36783. A typical Hodgkin's disease of submaxillary gland. Phosphotungstic acid and hematoxylin stain, X210.

region anterior to the sternocleidomastoid muscle. Clinical impression was malignant tumor of the submaxillary gland or a primary bony neoplasm arising in the mandible. At operation a firm reddish-gray neoplasm 4 by 4 by 3 centimeters was shelled out of the right submaxillary gland. The surgeon's diagnosis was mixed tumor.

A pathologic diagnosis of atypical Hodgkin's disease was made on the basis of neoplastic destruction of normal submaxillary gland pleomorphism abundance of reticulum cells young and old lymphocytes and eosinophilic fibrosis necrosis and the presence of large multinucleated giant cells suggestive of the Reed-Sternberg type (Fig. 10).

Follow up 4 1/2 years later revealed the patient to be still living.

#### DISCUSSION

Adenomas of the salivary glands have been reported by several authors. McFarland (5) presented a critical review of a large number of cases reported as adenoma of salivary gland and added 1 case of his own.

He regarded most of the so-called adenomas as variants of the mixed tumor showing a preponderance of glandular tissue and questioned the evidence in favor of their originating from salivary gland *per se*. Harris (2) described the morphology of 1 case in detail. He concluded that the tumor in his case arose from duct epithelium. This view is an acceptable interpretation of the first 2 cases presented here since the histologic appearance of the neoplastic cells in both cases is suggestive of the duct epithelium of salivary glands. Additional evidence of the adenomatous nature of the tumors is the fact that both were encapsulated. Clinical information regarding these cases is inadequate and no diagnostic criteria for recognition of these tumors preoperatively can be deduced.

Salivary gland angiomas have been encountered infrequently. McFarland (6) mentions 2 of unspecified type. Both were seen in infants. In the present group 2 were of blood vessel type and 1 of lymphatic derivation. In 2 the duration was from childhood,



Fig. 7 M. F. 33006 Papillary adenocystoma lymphomatousum. Hematoxylin and eosin stain, X72

ovoid, slightly movable tumor 3 by 2 by 2 centimeters in the region of the right parotid gland and a smaller roughly spherical mass 5 centimeters in diameter lying beneath it. Although the primary choice was parotid tumor a clinical diagnosis of lymphoma was considered because of the enlarged node in the left side of the neck and a palpable node in the groin. At operation two tumors were excised from the right parotid gland. The larger measured 5 by 4 by 3 centimeters and occupied the middle and upper portions of the gland the smaller was in the lower half of the gland and measured 5 by 3 by 2 centimeters. There was no definite plane of cleavage.

Examination of the specimens showed normal salivary gland incorporating firm pale gray rubbery well vascularized, homogeneous tumor than histologic study showed some residual parotid gland but the significant change was the extensive replacement by mature and immature lymphoid elements. The widespread invasion by young and old lymphocytes with many cells in mitosis indicated diagnosis of lymphosarcoma (Fig. 9).

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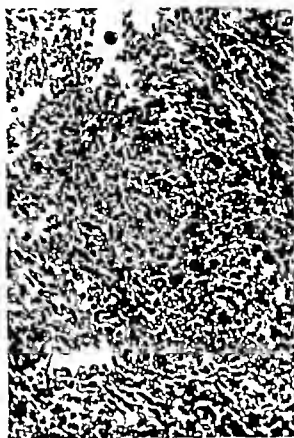


Fig. 8 A. J. S., 35-A-82. Leiomyosarcoma of parotid gland. Phosphotungstic acid and hematoxylin stain, X475.

jaw closely attached to the lower portion of the parotid gland. It had been painful on occasions. The mass was first noted 5 months previously after recovery from a respiratory infection. Physical examination revealed a fixed, nontender oval mass, 13 by 9 by 8 centimeters lying beneath the angle of the jaw on the right side. Intraoral examination was negative. A clinical diagnosis of lymphoma or metastatic tumor was made. Biopsy was performed. At operation the new growth lay within the right parotid gland and there was no obvious line of demarcation. Gross and microscopic study substantiated the clinical impression of lymphoma. The final diagnosis was malignant lymphocytoma. No evidence of recurrence following radiation therapy was reported in a follow up examination 5 years later.

CASE 13 C. B. a 51 year old white woman was seen because of a tumor near the angle of the right side of the jaw which had been present for 3 months and had recently been increasing in size. On examination the mass was fixed to the tissues, lay in or near the submaxillary gland and was described as being the size of a hen's egg. Some enlarged cervical nodes were found in the supraclavicular



Fig 9. Lymphosarcoma of parotid gland. Eosin and methylene blue stain,  $\times 90$ .

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Follow up 4½ years later revealed the patient to be still living.

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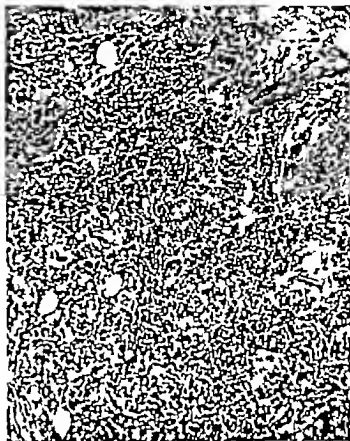


Fig 10. C. B., 36783. A typical Hodgkin's disease of submaxillary gland. Phosphotungstic acid and hematoxylin stain,  $\times 210$ .

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Salivary gland angiomatosis has been encountered infrequently. McFarland (6) mentions 2 of unspecified type. Both were seen in infants. In the present group 2 were of blood vessel type and 1 of lymphatic derivation. In 2 the duration was from childhood,

and the third occurred in an infant. Clinically the long duration of the tumor while not specific for angioma, would tend to exclude the diagnosis of mixed tumor. Furstenberg indicates that the appearance of mixed tumors of the salivary gland is most common in the third or fourth decades. At the time of operation the unusual bleeding of the hemangiomas was suggestive of the type of growth.

Perineurial fibroma of the salivary glands is seen rarely. McFarland (6) reported 2 cases, 1 with recurrence. Its origin is from the main trunk or a branch of the seventh nerve. Thus it arises within but not actually from the parotid gland. Developing in childhood and growing slowly it usually results in the signs of tumor only. Occasionally there may be twinges of pain. The diagnosis may be surmised clinically but is actually based upon the microscopic picture. Some may undergo malignant change. After the material for this paper was gathered a 2 year old child was operated upon by Dr. R. B. Cattell because of a large mass involving the right parotid gland. This proved to be a perineurial fibrosarcoma of low grade malignancy.

Lately there has been much interest in that bizarre tumor of the salivary gland the papillary adenocystoma lymphomatosum. In 1937 Harris (3) described the entity and reviewed the literature. Joyce and associates described a series of 4, one of which showed an early adenocarcinoma and another a squamous cell carcinoma. The characteristics of this new growth have been elaborated so clearly that further discussion is unnecessary. Case 8 is unusual in that the tumor occurred bilaterally. We believe that this tumor is not an uncommon one. In the past year we have encountered 6 additional examples including another case of bilateral tumors.

Leiomyoma of a salivary gland is so rare as to justify reporting it alone. In the case described it arose in the right submaxillary gland. It was encapsulated and easily excised. The histogenesis is unknown. None of the more extensive works has included this particular histologic form. Its clinical diagnosis would be improbable.

The malignant counterpart of the leiomyoma proved to be a confusing neoplasm

and the diagnosis was not established until an autopsy had been performed. An incorrect structural diagnosis had been made on the basis of an aspiration biopsy. The origin of such sarcoma in the parotid gland is obscure. It could conceivably arise in the walls of blood vessels. The response to radiation therapy was unsatisfactory and the clinical course corresponded to that of a carcinoma. Cytologic study showed a typical malignant smooth muscle neoplasm. Special stains were confirmatory. There are no criteria other than microscopic appearance for the diagnosis of this tumor.

Malignant lymphoid neoplasms may arise in the salivary glands. All 3 of the cases reported here were primary on the right side. Two originated in the parotid and 1 in the submaxillary gland. They were characterized by rapid enlargement in the fifth or sixth decades of life. In 1 case a clinical diagnosis of lymphoma was entertained because of associated cervical adenopathy. The diagnosis in all cases was established by microscopic study. Three types are represented—lymphosarcoma, malignant lymphocytoma, and atypical Hodgkin's disease.

#### SUMMARY

Thirteen uncommon tumors of the salivary glands have been presented: adenoma, 2 cases; hemangioma, 2; lymphangioma, 1; perineurial fibroma, 1; papillary adenocystoma lymphomatosum, 2; leiomyoma, 1; leiomyosarcoma, 1; lymphomas, 3 cases—lymphosarcoma, malignant lymphocytoma, and atypical Hodgkin's disease.

An attempt has been made to give certain criteria which may aid in their clinical diagnosis.

Although the greatest number of neoplasms arising in the salivary glands are mixed tumors it should be remembered that other types of tumors may also arise in them.

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# STIMULATION OF OVARIAN FUNCTION AND INDUCTION OF PREGNANCY THROUGH INTRAVAGINAL IMPLANTATION OF ESTROGEN PELLETS

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THE problem of amenorrhea plays a very significant role in the treatment of sterility. When ovarian function is at a standstill ovulation does not occur the building up of the uterine mucosa is inhibited and as a result, it becomes impossible for fertilization to take place. Since the discovery of the central regulation of ovarian function through the gonadotropic hormone of the anterior pituitary lobe (12 13 28) we distinguish between several types of amenorrhea (20) (a) prolagenic or hypophyseal (b) estrogenic (c) progestogenic (d) hypothalamic (4).

In groups b and c it is necessary to differentiate between ahormonal or oligohormonal and polyhormonal types (15). In the ahormonal and oligohormonal conditions comprising the majority of the cases amenorrhea is caused by the absence or the insufficient production of the ovarian hormones. With complete cessation of ovarian function (ahormonal condition) an excess of follicle-stimulating hormone is produced in the anterior pituitary lobe and is excreted in the urine (14). In a castrated woman the follicle stimulating hormone content of the urine rises from 10 to 100 mouse units per litre as early as 14 days after the operation and the same occurs physiologically at the climacterium (14). Low excretion of estrogens combined with deficient excretion of follicle stimulating hormone indicates hypophyseal amenorrhea, combined with increased excretion of follicle stimulating hormone ovarian amenorrhea and with normal excretion of follicle stimulating hormone hypothalamic amenorrhea (4). The polyhormonal conditions depend on a disturbance in the ovarian function leading to the persistence of the follicles

or of the corpus luteum with hypersecretion of estradiol and progesterone respectively.

Amenorrhea may be the symptom of a general disease such as diabetes blood disease by perthyroidism or hypothyroidism or it may be the result of psychic or climactic factors. In such cases one must attempt to cure the amenorrhea through the elimination of the underlying disease. Actually however many amenorrheas are of endocrine origin reflecting a disturbance in the pituitary-ovarian relationship. We are employing a therapy of substitution when we first bring about proliferation of the uterine mucosa in an amenorrheic patient with the aid of estrogenic hormone then induce mucosal function through the administration of progesterone and finally bring on a true menstruation by withdrawal of the hormones. On the other hand when we attempt to stimulate the ovarian function with gonadotropic hormone we are employing a hormoneotropic stimulation therapy (Zondek). The final object of all treatment must be to initiate rhythmic function of the gonadotropic hormone in the anterior pituitary lobe.

The anterior pituitary gland is the motor of sexual function (12 13 28). Under the influence of gonadotropin estradiol is produced in the follicular theca cells and this hormone exerts a reciprocal effect on the anterior pituitary function. In 1931 the senior author summarized (18) his investigations as follows:

Estrogenic hormone acts both as a stimulator and an inhibitor of the function of the anterior pituitary lobe with the result that the estrogenic hormone produced in the ovary under the influence of the anterior pituitary has a regulating effect on its producer. The motor of the sexual function is thus regulated by the substance it produces since small doses of estrogens stimulate while large doses inhibit it.

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and the third occurred in an infant. Clinically the long duration of the tumor while not specific for angioma, would tend to exclude the diagnosis of mixed tumor. Furstenberg indicates that the appearance of mixed tumors of the salivary gland is most common in the third or fourth decades. At the time of operation the unusual bleeding of the hemangiomas was suggestive of the type of growth.

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Lately there has been much interest in that bizarre tumor of the salivary gland the papillary adenocystoma lymphomatousum. In 1937 Harris (3) described the entity and reviewed the literature. Joyce and associates described a series of 4, one of which showed an early adenocarcinoma and another a squamous cell carcinoma. The characteristics of this new growth have been elaborated so clearly that further discussion is unnecessary. Case 8 is unusual in that the tumor occurred bilaterally. We believe that this tumor is not an uncommon one. In the past year we have encountered 6 additional examples including another case of bilateral tumors.

Leiomyoma of a salivary gland is so rare as to justify reporting it alone. In the case described it arose in the right submaxillary gland. It was encapsulated and easily excised. The histogenesis is unknown. None of the more extensive works has included this particular histologic form. Its clinical diagnosis would be improbable.

The malignant counterpart of the leiomyoma proved to be a confusing neoplasm

and the diagnosis was not established until an autopsy had been performed. An incorrect structural diagnosis had been made on the basis of an aspiration biopsy. The origin of such sarcoma in the parotid gland is of

it could conceivably arise in the walls of blood vessels. The response to radiation therapy was unsatisfactory and the clinical course corresponded to that of a carcinoma. Cytologic study showed a typical malignant smooth muscle neoplasm. Special stains were confirmatory. There are no criteria other than microscopic appearance for the diagnosis of this tumor.

Malignant lymphoid neoplasms may arise in the salivary glands. All 3 of the cases reported here were primary on the right side. Two originated in the parotid and 1 in the submaxillary gland. They were characterized by rapid enlargement in the fifth or sixth decades of life. In 1 case a clinical diagnosis of lymphoma was entertained because of associated cervical adenopathy. The diagnosis in all cases was established by microscopic study. Three types are represented—lymphosarcoma, malignant lymphocytoma and atypical Hodgkin's disease.

#### SUMMARY

Thirteen uncommon tumors of the salivary glands have been presented: adenoma, 2 cases; hemangioma, 2; lymphangioma, 2; perineural fibroma, 1; papillary adenocystoma lymphomatousum, 2; leiomyoma, 1; leiomyosarcoma, 1; lymphomas, 3 cases—lymphosarcoma, malignant lymphocytoma, and atypical Hodgkin's disease.

An attempt has been made to give certain criteria which may aid in their clinical diagnosis.

Although the greatest number of neoplasms arising in the salivary glands are mixed tumors, it should be remembered that other types of tumors may also arise in them.

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# STIMULATION OF OVARIAN FUNCTION AND INDUCTION OF PREGNANCY THROUGH INTRAVAGINAL IMPLANTATION OF ESTROGEN PREPARED

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THE problem of amenorrhea plays a very significant role in the treatment of sterility. When ovarian function is at a standstill ovulation does not occur the building up of the uterine mucosa is inhibited and as a result it becomes impossible for fertilization to take place. Since the discovery of the central regulation of ovarian function through the gonadotropic hormone of the anterior pituitary lobe (12, 13, 28) we distinguish between several types of amenorrhea (20): (a) prolactogenic or hypophyseal (b) estrogenic (c) progestogenic (d) hypothalamic (4).

In groups b and c it is necessary to differentiate between ahormonal or oligohormonal and polyhormonal types (15). In the ahormonal and oligohormonal conditions comprising the majority of the cases amenorrhea is caused by the absence or the insufficient production of the ovarian hormones. With complete cessation of ovarian function (ahormonal condition) an excess of follicle stimulating hormone is produced in the anterior pituitary lobe and is excreted in the urine (14). In a castrated woman the follicle stimulating hormone content of the urine rises from 10 to 100 mouse units per litre as early as 14 days after the operation and the same occurs physiologically at the climacterium (14). Low excretion of estrogens combined with deficient excretion of follicle stimulating hormone indicates hypophyseal amenorrhea combined with increased excretion of follicle stimulating hormone ovarian amenorrhea and with normal excretion of follicle stimulating hormone hypothalamic amenorrhea (4). The polyhormonal conditions depend on a disturbance in the ovarian function leading to the persistence of the follicles

or of the corpus luteum with hypersecretion of estradiol and progesterone respectively.

Amenorrhea may be the symptom of a general disease such as diabetes blood disease hyperthyroidism or hypothyroidism or it may be the result of psychic or climactic factors. In such cases one must attempt to cure the amenorrhea through the elimination of the underlying disease. Actually however many amenorrheas are of endocrine origin reflecting a disturbance in the pituitary-ovarian relationship. We are employing a therapy of substitution when we first bring about proliferation of the uterine mucosa in an amenorrheic patient with the aid of estrogenic hormone then induce mucosal function through the administration of progesterone and finally bring on a true menstruation by withdrawal of the hormones. On the other hand when we attempt to stimulate the ovarian function with gonadotropic hormone we are employing a hormoneotropic stimulation therapy (Zondek). The final object of all treatment must be to initiate rhythmic function of the gonadotropic hormone in the anterior pituitary lobe.

The anterior pituitary gland is the motor of sexual function (12, 13, 28). Under the influence of gonadotropin estradiol is produced in the follicular theca cells and this hormone exerts a reciprocal effect on the anterior pituitary function. In 1931 the senior author summarized (18) his investigations as follows:

Estrogenic hormone acts both as a stimulator and an inhibitor of the function of the anterior pituitary lobe with the result that the estrogenic hormone produced in the ovary under the influence of the anterior pituitary has a regulating effect on its producer. The motor of the sexual function is thus regulated by the substance it produces since small doses of estrogens stimulate while large doses inhibit it.

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Implantation may be successfully done in the posterior wall of the vagina about 2 centimeters beyond the vaginal orifice. Following infiltration with 0.5 per cent novocain a small incision is made in the mucosa and with the aid of a forceps this is very easily converted into a cavity in the submucosa in which several pellets may be implanted at different sites. Fuller details of the technique may be found in the original paper (27).

**Dosage** The question of the amount of hormone to be implanted is of decisive importance. If the dose is too small the effect is negligible. If it is too large the resulting stimulation of the uterine mucosa (peripheral effect) has a disturbing influence leading to unpleasant clinical symptoms such as bleeding which will be more fully discussed. The dosage must be independently determined in each case. In cases of secondary amenorrhea we may take as a base line a dose of no more than 30 to 35 milligrams of estrone or estradiol for the first implantation about 25 milligrams for the second implantation which follows after an interval of about 3 to 6 months and the same dose for a third implantation several months later. In primary amenorrhea the initial dose may be 35 to 50 milligrams maximum and implantations of 30 to 40 milligrams may follow.

**Preparation of the pellets** The pellets were produced as follows: 10 to 25 milligrams of hormone (estrone or estradiol) without the addition of any binding substance were pressed by hand into a brass tube 2.5 millimeters in diameter with the aid of a brass piston. The pellets thus produced had a diameter of 2.5 millimeters and were 1 to 3 millimeters thick. The pellets were sterilized by dry heat for 24 hours at 100 degrees C.

**Effect of the pellets** The constant resorption of estrogenic hormone from the pellets provides the body with a protracted hormonal stimulus which has the following effects:

**Central effect** i.e. stimulation of the gonadotropic function of the anterior pituitary gland with consecutive production of the ovarian hormones.

**Peripheral effects** (a) stimulation of uterine growth and of proliferation of the uterine mucosa (b) probable stimulation of the ovary.

Stimulation of the production of gonadotropins in the anterior pituitary lobe (follicle stimulating hormone and luteinizing hormone) leads to the production of sex hormones in the ovary specifically of estradiol in the theca cells and of progesterone in the granulosa cells (central effect). These substances in turn stimulate the uterine mucosa leading to proliferation of and secretion by the mucous membrane thus preparing it for the nidation of the fertilized ovum. Moreover the pellet containing estrogens causes a direct (peripheral) stimulation of the uterus of its vegetative function in increased uterine growth as well as of its generative function proliferation of the uterine mucosa. Certain experimental studies suggest that the ovary may also be stimulated by the estrogenic hormone. Pencharz working with infantile hypophysectomized rats implanted diethylstilbestrol and followed this by treatment with chorionic gonadotropin thereby not only inhibiting the atrophy of the ovary but actually obtaining considerable increase in weight with enlargement of the follicles and the corpora lutea. Similar results obtained by other authors (3, 8, 9, 11) suggest the conclusion that the estrogenic hormone renders the ovary sensitive to the influence of hypophyseal gonadotropin. It is quite possible that this effect is implicated in our cases as well and that the restoration of the cycle may perhaps be favored by it in that the central effect of gonadotropic stimulation is combined with the peripheral effect on the ovary leading to further sensitization of the ovary to gonadotropin.

Too strong an induction of the peripheral effect on the uterine mucosa may result in hyperproliferation (glandular cystic hyperplasia) which is sometimes known to provoke bleedings often of a severe nature. We have observed this undesirable by-effect and have several times been obliged to perform curettage in cases of protracted or occasionally of violent bleeding. An attempt should first be made to check the bleeding through the administration of 10 milligrams of progesterone daily for 5 days and only if this proves unsuccessful should curettage be performed. Following curettage the cycle is sometimes spontaneously initiated but in other cases amen-

## EXPERIMENTAL STUDIES

Experimental studies of the senior author have demonstrated (22-23) that uninterrupted treatment with large doses of estrogens is capable of inhibiting the function of the anterior pituitary lobe actually affecting certain specific functions one of the most sensitive of which is the gonadotropic function followed in that order by inhibited production of growth hormone. If rats or fowl are treated for several months with estrogens they develop into eunuchoid dwarfs. Body growth is inhibited in such animals by as much as 60 per cent, and the development of ovaries and testes by 95 per cent. Atrophy of the sex glands, absence of follicular maturation and of corpus luteum formation and inhibition of spermatogenesis are all complete. Estrogenic hormone may thus induce partial biological resection of the anterior pituitary, since the gonadotropic function and the production of growth hormone are thereby inhibited, while the other hormonotropic functions are only slightly or not at all affected. Whereas inhibition of the anterior pituitary by means of large doses of estrogens is easy to achieve, experimental stimulation is extremely difficult and may be carried out only with small doses of hormone. It is important that the hormone be constantly absorbed and that it exert a continuous effect on the anterior pituitary, a condition which was found not to be fulfilled when hormone was injected, since in this case over rapid resorption was followed by excessively rapid enzymatic inactivation in the liver (16-17-29-30). Deane and Parkes (1-2) demonstrated that the desired continuous resorption was achieved when hormone pellets were administered as only 1 to 5 per cent was resorbed daily when this method was employed. Stimulation of the anterior pituitary was obtained in rats and rabbits with the aid of the implantation technique (25-26). The production of growth hormone, gonadotropic hormone, lactotropic hormone and in other experiments of thyreotropic hormone were all stimulated thereby. To begin with the last mentioned effect it was thus possible to imitate the human syndrome of Graves disease in laboratory animals. The animals exhibited loss of weight, nervous irritability, increased basal metabolism, typical electrocardiographic

changes and extreme exophthalmos. Furthermore giant animals were produced with enormously enlarged mammary glands, markedly increased milk secretion and ovarian hypertrophy with marked development of luteal tissue. Thus it proved possible through continued exposure to small quantities of estrogenic hormone to stimulate the secretion of various hormonotropic factors of the anterior pituitary lobe.

## CLINICAL STUDIES

On the basis of the experimental results, we attempted to stimulate the function of the anterior pituitary lobe by means of uninterrupted action of estrogenic hormone in man as well. Here too after attempts at injection had proved unsatisfactory, the implantation of pellets appeared promising. We then tried the implantation of pellets in the customary manner subcutaneously or intramuscularly on the upper thigh or on the abdominal wall, but we were dissatisfied with the results thus obtained. The efficacy of this method varied from case to case, probably because the pellets implanted in subcutaneous tissue were readily encapsulated and were thus rendered inactive due to the fibrous growth whose intensity varies in different people. We then demonstrated experimentally that the activity of estrogenic hormone was greatly increased when the hormone was injected near its target organ, i.e. in the vaginal submucosa. The dose of estrone required to elicit estrus by the intravaginal route is only a fifth of the subcutaneous and intramuscular doses required. Therefore we chose the intravaginal pellet implantation (Zondek) which has the following advantages (27):

a. Absorption is much more constant than in the case of subcutaneous implantation, probably because the blood supply of the vagina is superior to that of the subcutaneous tissue.

b. The effective activity of pellets implanted submucosally in the vagina is about 5 times that of pellets implanted subcutaneously.

c. Expulsion of pellets such as sometimes occurs following subcutaneous implantation, is rare.



orrhea recurs necessitating a second implantation. The disagreeable by-effects should not discourage further implantations, since stimulation of the anterior pituitary must be the constant aim. We have arrived at this point of view on the basis of the following observations. Repeated intravaginal implantation was capable of inducing not only uterine growth producing an organ of normal size, but also restoring ovarian function and ultimately pregnancy in women who had been amenorrheic for years and had exhibited symptoms of complete inhibition of ovarian function such as very small, atrophic uterus atrophic mucosa complete absence of estrogenic reaction in vaginal smears, increased secretion of follicle stimulating hormone (110 mouse units or more per litre urine) symptoms of vasomotor insufficiency etc. We have been able in recent years almost completely to avoid the bleedings induced by implantation since we have determined the proper dosage. Bleedings were brought on by the implantation of 50 to 75 milligrams of estradiol doses which we have since rejected as excessive since we now consider 40 milligrams to be the maximal permissible dose.

*Success of the treatment.* Sixty-two women were treated for amenorrhea by intravaginal implantation. The pellets consisted of either estradiol or in most cases of estrone. Seven of the patients suffered from primary amenorrhea i.e. they had never yet menstruated and 55 of them had secondary amenorrhea of 2 to 10 years duration. Of these 62 patients, 52 responded with bleedings and 38 of them reported several cyclic bleedings following a single implantation while 26 had regular bleedings up to 12 months. In 12 cases the cycle was completely established and 8 of these women became pregnant.

Fifty-four of the 62 patients were married and since 8 of the patients became pregnant the treatment was entirely successful in 14.8 per cent of the cases. It should indeed, be emphasized that we did not consider any other possible causes of sterility as we were particularly concerned with the initiation of ovarian function and ovulation which is the prerequisite condition for fertilization. Some of our patients may have had occluded tubes or

other causes for sterility so that our 14.8 per cent would represent the minimal number of successful treatments.

In this study we will not describe in detail all of the 62 cases in which patients were treated by intravaginal implantation but only those which culminated in pregnancy.

The following case demonstrates the disadvantages of the method i.e., the marked local stimulation of the uterine mucosa with severe bleeding. It should be noted however that these accessory phenomena have been avoided in recent years, since the dosage has been more carefully worked out. As may be seen in the case history we implanted 50 milligrams of estrone a dose which we would now consider excessive since we do not now exceed doses of 25 to 30 milligrams in cases of secondary amenorrhea. In spite of the bleeding, which is certainly to be regarded as an unpleasant accessory phenomenon we successfully induced ovarian function and reinitiated the cycle in a woman amenorrheic for 6 years.

*Case S.* Aged 29 years childless after 9 years of married life was completely amenorrheic for the past 6 years and suffered from symptoms of vasomotor insufficiency. The uterus was atrophic, the mucosa very thin, containing only a few scattered glands in a resting condition. Examination of a vaginal smear revealed estrogenic insufficiency. On March 16, 1943 intravaginal implantation of 50 milligrams of estrone was done. Fifty-two days later the patient bled for 3 days and a severe bleeding, necessitating curettage followed 23 days thereafter. Strip curettage revealed marked glandular cystic hyperplasia of the mucosa. Amenorrhea returned following the curettage.

A second intravaginal implantation of 50 milligrams of estrone was made in January 1943. After an interval of 4 months, severe bleeding again necessitated curettage. Marked glandular hyperplasia was again observed in the mucosa. However after this curettage menstruations lasting for 4 to 5 days set in at intervals of 28 days, and the patient was completely cured of her 6 years' amenorrhea.

#### PREGNANCIES

In 8 cases implantation induced not only bleedings but regular cycles with ovulation, as demonstrated by the fact that the patients became pregnant. We treated only such patients as appeared to us clinically severe and with unpromising prognosis. All our patients exhibited marked degeneration of the genital organs details of the symptoms are presented

below All had already been unsuccessfully treated for extended periods of time One patient, a 26 year old woman had menstruated only a few times in her life in other words she actually represented a case of primary amenorrhea The 7 others were cases of secondary amenorrhea of between 2 and 5 years duration Sterility had lasted for 3 to 7 years with an average period of 4.6 years. The following are detailed histories of the cases

### Primary Amenorrhea

CASE 1 Th G a 26 year old woman childless after 3 years of marriage first menstruated at the age of 15 Slight bleedings followed at intervals of several months for 2 years. Then menstruation ceased. The patient suffered from nervousness sometimes amounting to depression actually brought on by a feeling of sexual inferiority

Examination revealed an atrophic vagina and an extremely infantile uterus with complete atrophy of the uterine mucosa. Total estrogenic deficiency was revealed by vaginal smear and by abnormally high urinary excretion of follicle stimulating hormone (333 mouse units per litre) Basal metabolism was +7 per cent. The case appeared almost hopeless due to the marked atrophy of the genitals Repeated implantation was nevertheless undertaken in the hope that this treatment might induce uterine growth and might perhaps reinitiate ovarian function

January 20, 1941 intravaginal implantation of 50 milligrams of estradiol was done Slight bleeding occurred 43 days thereafter Strip curettage showed that the mucosa had already developed to a certain extent, corresponding approximately to the 12th to the 14th day of the cycle The follicle stimulating hormone litre units per litre of the urine had fallen from 333 to 86 mouse units per litre On May 13, 1941 i.e. 112 days after implantation bleeding again occurred and 4 cyclic bleedings followed at intervals of 28 days. The significant growth of the uterus which now appeared almost normal in size was striking The previously somewhat atrophic breasts were greatly enlarged and painful After ovarian function had continued rhythmically for 4 months with progressive development of the mucosa indicating ovulation (proved by strip curettage) an amenorrhoeic period of 3 months duration followed whereupon an additional intravaginal implantation of 40 milligrams of estradiol was administered Two months later the cycle was reinitiated and 12 regular bleedings occurred. In February 1943 the patient became pregnant and a normal birth followed. The cycle remained normal after the patient gave birth and she became pregnant a second and a third time

In this apparently almost hopeless case repeated implantation had resulted in complete functional success

### Secondary Amenorrhea

CASE 2 Ch W a 34 year old woman, childless after 4 years of marriage first menstruated at the age of 16 followed by irregular menstruations at intervals of 4 to 6 months Amenorrhea had been complete for the past 2 years If the bleedings induced by hormone injections are included in the calculation the patient must be considered to have been amenorrhoeic for at least 6 years

The sex organs were markedly underdeveloped the uterus being small and the uterine mucosa very atrophic thin containing only a few glands. The breasts were very underdeveloped Conspicuous symptoms of vasomotor insufficiency were noted such as flushes and attacks of perspiration irritability and insomnia.

September 1, 1941 50 milligrams of estradiol were implanted intravaginally Several weeks later the patient felt a distinct subjective improvement the flushes diminished in severity the nervous irritability subsided and her breasts had developed to a certain extent. The patient noted particularly that the hitherto constant dryness of the vagina during cohabitation no longer persisted Eighty-eight days after implantation a 10 day bleeding period set in (November 27, 1941) and bleedings recurred in December 1941 and in January and February 1942 Since no bleedings occurred in March and April, a second implantation of 30 milligrams was administered Two months later bleeding recurred and the patient became pregnant during the following month Pregnancy and birth were normal

CASE 3 L Z 30 year old woman childless after 6 years of marriage first menstruated at 13 years Menstruation was regular until 2 years previous to examination since when no bleedings had occurred During this period the patient had been suffering from severe nervous symptoms headaches and depressive states.

Examination revealed a somewhat atrophic vagina and no estrogenic activity was revealed by vaginal smear The uterus was very atrophic, with a thin mucosa containing only a few glands in the postmenstrual stage

July 7, 1941 35 milligrams of estradiol were implanted intravaginally but this treatment remained ineffective whereupon a second intravaginal implantation of 50 milligrams of estradiol was carried out on October 24, 1941 In consequence a bleeding was induced which began on January 1, 1942 and became progressively more severe so that curettage became necessary by the end of the third week and a very hyperplastic mucosa was removed at this operation Bleedings recurred in February and March and these were followed by an amenorrhoeic period, necessitating a third intravaginal implantation of 35 milligrams of estradiol in January 1943 Bleeding was re-established in March 1943 and normal menstruations followed for 8 months when in December 1943 the patient became pregnant Birth was normal

(vaginal smear) diminution in size of the uterus atrophy of the uterine mucosa increased excretion of follicle stimulating hormone, and the secondary phenomena of vasomotor insufficiency characteristic of the climacterium.

In a former study (24, 31, 32) we demonstrated that it is possible to induce bleeding from the atrophic mucosa of amenorrhoeic patients by the injection on 2 successive days of 5 milligrams of estrone and 50 milligrams of progesterone<sup>1</sup>. It is also feasible to induce this effect with a single injection when the hormones are administered not in an oily solution but in the form of a precipitation of microcrystals of a specific size (33).

If 3 or 4 bleedings are induced by treatments repeated at intervals of about a month, ovarian function may be restored in a certain number of cases, and rhythmic bleedings ensue. It must therefore be concluded as already pointed out by A. Westman<sup>2</sup> and G. V. Smith, (10) that the cyclic estrogen-progesterone withdrawal flow plays a physiological role in the cyclic pituitary-ovarian interaction. The present investigation demonstrates that the same effect may also be obtained by continuous stimulation with estrogenic hormone flowing from the pellet reservoir. Apparently the central stimulation of the gonadotropic function of the anterior pituitary lobe combines with the peripheral stimulation of the ovary sensitizing the latter to the influence of pituitary gonadotropin. As a result the central mechanism—that of the anterior pituitary as the motor of sexual function—appears to be reinitiated.

#### SUMMARY

1. Estrogen pellets were implanted intravaginally in severe cases of amenorrhea with consequent sterility.

2. Intravaginal implantation possesses the following advantages over subcutaneous administration. (a) The effect is more constant, since the connective tissue enveloping the introduced hormone in the vaginal submucosa

is much less dense than that in the subcutaneous tissue. (b) The effect is about 5 times as intense. (c) The tablets are seldom expelled.

3. The effects of implantation are manifested in improved vascularization of the vagina in changes in the vaginal epithelium (cornified cells) in uterine growth proliferation of the uterine mucosa uterine bleeding and enlargement of the breasts.

4. The average interval between implantation and the onset of bleeding is 78 days.

5. The cycle may be reinitiated by a single intravaginal implantation whereby the amenorrhea is relieved. Alternatively several cyclic bleedings may occur which are again followed by amenorrhea requiring a second implantation after a certain period, or even a third in obstinate cases. A second implantation is also indicated if no bleeding occurs within 3 to 4 months of the initial implantation. The effect of implantation may be estimated by vaginal smear and by the examination of the uterine mucosa obtained by a diagnostic strip curettage.

6. The dosage, which must vary with the severity of the clinical symptoms, is of paramount importance. Doses may range between 25 and 50 milligrams of estrone or estradiol. Doses higher than 50 milligrams are not to be administered.

7. An unwelcome accessory effect sometimes associated with our treatment is an excessively intense peripheral reaction involving glandular cystic hyperplasia of the uterine mucosa, sometimes accompanied by severe bleeding requiring treatment with progesterone or if necessary with curettage. This accessory effect should not discourage a repetition of implantation employing a smaller dose should amenorrhea reappear. Moreover excessive bleeding may be avoided if not more than 30 to 40 milligrams of estrogen be implanted.

8. Mechanism of the effect. Estrogenic hormone leads to central stimulation of the anterior pituitary lobe whereby the secretion of gonadotropin is induced. Furthermore, a peripheral effect on the ovary is probably also induced rendering the ovary more sensitive to the influence of gonadotropin.

9. We have carried out intravaginal implantation in 54 married women suffering from

<sup>1</sup>The interval between hormone inoculation and bleeding consists of 1 to 3 days following the day administration of only solutions of hormones, and of 1 to 3 days following the administration of one injection of hormone microcrystals.

<sup>2</sup>Acta Obst. gyna. scand., 1935, 5.

amenorrhea of many years duration accompanied by severe secondary changes of the genital organs. Bleeding was induced in 84 per cent of the amenorrhoeic patients. In 8 of the treated cases (14.8 per cent) not only was the amenorrhea cured but pregnancy actually ensued. Since other possible factors leading to sterility were not taken into account as the amenorrhea was the condition most obviously requiring treatment it may be that the percentage of successful treatments of sterility ought to be estimated at a higher figure. For implantation only such cases were selected which were prognostically unpromising and which had previously been under other types of treatment for years without any success. It is worthy of note that 1 of our patients who had menstruated only a few times in her life and whose genital organs were as undeveloped as before puberty responded to our treatment with complete initiation of genital function culminating in pregnancy.

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### INTRAEPITHELIAL CARCINOMA (IN SITU) OF THE CERVIX UTERI

**I**N the absence of complete and specific knowledge of the cause of cancer we obviously cannot prevent its occurrence to any great degree. The second best thing that we can do is to recognize it in its incipency and perfect our therapy at that early stage. Cancer of the cervix uteri is the malignancy which occurs most frequently in the female pelvis. It is second only to breast carcinoma in frequency of malignancy in women. Hence any decisive blow that can be taken at it will materially reduce the death rate of women from cancer. Since the cervix is essentially a surface organ it lends itself readily to inspection and biopsy. Thus cervical cancer is an ideal lesion for early detection.

In 1912 Schottländer and Kermauner described cellular changes in the surface epithelium about the periphery of invasive cervical cancer that were identical to the cellular changes in the depth of invasive cancer. They

believed that invasive cancer sometimes spread on the surface in this manner. It remained for Schiller who began his studies in the twenties and continued them into the thirties to conceive the idea that true cervical cancer might begin as a surface lesion and remain such for a considerable period before entering the invasive stage. To substantiate his belief that these surface lesions were actually cancer Schiller presented histological evidence that was suggestive if not conclusive. He also published clinical facts which supported his views such as one recurrence after five years and two recurrences in less than five years after hysterectomy. At the present time there are approximately twenty cases in the literature in which death resulted after treatment of an apparent intraepithelial carcinoma or in which patients presented themselves with advanced cervical cancer several years after a recorded biopsy which showed carcinoma in situ. In some instances a period of as long as twelve years had elapsed between the time the biopsy was taken and clinical cancer appeared. Among these cases are those of Stevenson and Sciplades, Pund, Smith and Pemberton, Schnitz and Benjamin Knight, Younge, Taylor and Guyer, Scheffey, Galvin and Te Linde.

The last two authors have made a prolonged and intensive study to prove histologically the relationship between carcinoma in situ and invasive cervical cancer. All cervixes which had shown noninvasive cancer on biopsy and which were subsequently removed were cut into blocks and many sections made from each block of tissue. Of a total of 75 cases they were able to demonstrate invasive cancer histologically in 35. In 10 cases more intraepithelial

cancer was found in the removed cervix and in the remaining 10 no abnormality was found in the entire cervix, indicating that either all the carcinoma in situ was removed at biopsy or that further carcinoma was missed in spite of the many sections. From these studies and from clinical data it would seem that the term intraepithelial cancer or carcinoma in situ should be used to indicate a microscopic picture and that such a microscopic picture found in a biopsy may indicate three possible clinical conditions: (1) a gross invasive cancer the periphery of which was biopsied. This is the condition originally described by Schottländer and Kermauner; (2) a cervix in which subclinical but microscopic invasive cancer exists; (3) a cervix in which the neoplasm is still strictly intraepithelial.

Hence in each instance in which the pathological report of carcinoma in situ is made the woman should be examined gynecologically and the gross findings correlated with the microscopic evidence. It is only in this way that a proper decision regarding therapy can be made.

It is interesting that in Pund's cases of intraepithelial cancer the average age was 36.6 years and in Galvin and Te Linde's group 37.1 years. Since the average age of patients with cancer of the cervix in its clinical form is 48 years it would appear that the noninvasive form of the disease may exist for many years before becoming grossly invasive and clinically apparent. This is simply another way of saying that the symptomatic life of a cervical cancer is a relatively short part of its entire existence.

Since the subject of carcinoma in situ and the cytological diagnosis of cervical cancer have come to the attention of the profession more or less simultaneously the relation of one to the other should be given serious consideration. Although the available data regarding

the value of smears in detecting carcinoma in situ are relatively meager compared with the biopsy data sufficient have been accumulated to indicate that many preinvasive carcinomas may be discovered by the study of cytology smears. The relatively or absolutely normal appearance of the cervix may make the taking of biopsies rather difficult. The smear technique does not present this difficulty. Since histological studies have shown that practically all intraepithelial cancers start at the columnar stratified junction biopsies should be taken there as well as from any isolated suspicious areas. However smears may be incorrectly taken as well as biopsies. A smear made by the blind introduction of a swab into the vagina is more apt to lead to a false negative report than a smear taken directly from the cervix. When one considers that the percentage of false negative reports for smears in the presence of gross cervical cancer is in the neighborhood of 10 per cent the greater likelihood of a false negative in the presence of the small nonulcerating noninvasive cancer becomes apparent. Two points should be emphasized in relation to cytology: (1) a positive smear should always be confirmed by biopsy before beginning treatment for cancer; (2) one should never rest assured that cancer is not present on the basis of a negative smear if the cervix looks at all suspicious. Biopsy examination of such a cervix should be done and should be repeated if necessary before one can be satisfied that no cancer is present.

Concerning the treatment of carcinoma in situ there is rather general agreement that total abdominal hysterectomy should be done. Galvin and Te Linde have reported that 67 patients operated upon from 8 years to 6 months before the report were living and free from evidence of cancer. The operation which they performed was called a 'modified Wer-

them. It consists of removal of the uterus with a centimeter or two of parametrium and a wide vaginal cuff. Lymph gland resection is not done, thus greatly reducing the magnitude of the operation. In the younger individuals an ovary was frequently spared and there were no recurrences among these patients. The authors stress the point that they do not advocate this modified Wertheim operation for clinical cervical cancer. There is little doubt that the percentage of cures of carcinoma in situ with irradiation would be high, but it is interesting that Galvin and Te Linde report one death among 8 patients treated by irradiation. This woman died in six months and autopsy showed metastatic cancer.

Our present knowledge of intraepithelial cancer based on sound clinical and pathological observations indicates that cervical cancer can be diagnosed at that stage and that the disease is then curable. An opportunity is thus offered to eradicate this serious and relatively frequent disease by the education of the public as to the value of periodic examinations and by the education of doctors to make the examinations which are necessary for the establishment of the diagnosis.

RICHARD W. TE LINDE

## THE USE OF METHIONINE IN OBSTETRICS

**A**NIMAL experimentation has shown that nephrosis in combination with wide spread liver damage may be caused by severe dietary restrictions. These manifestations were demonstrated to be similar to those found in patients who died due to conditions which produced the clinical picture of the so called hepatorenal syndrome. Certain agents such as chloroform or phosphorus caused marked liver necrosis but this de-

struction was contingent on the fact that protein-deficient diet played the predisposing role. Furthermore experimental work showed that the nutritional necrosis which was found in the liver of these animals had some similarity to the pathological changes of the liver in eclamptic patients. Investigators proved that these conditions in animals could be prevented by the administration of choline plus cystine or by the use of methionine.

Hypoproteïnism is a common finding in these conditions. This protein depletion may be the common factor which renders the liver and kidneys more susceptible to hepatotoxic agents. Glycogen has been established as a protective agent to the liver and kidney but it is only recently that protein has been proved to play an important role in the protection of all tissues of the body. In fact, it is possible for normal liver and kidney function to be maintained only if there is adequate protein intake.

When protein depletion does occur correction to the proper levels may be facilitated by the intravenous administration of plasma, protein hydrolyzates, or by the use of methionine. It is estimated that approximately three grams of methionine is the normal daily intake for an adult. Due to the fact that methionine is an essential amino acid it is not synthesized in the body but must be provided from foods or be given as a supplement to the diet.

Experimental work has shown methionine to be lipotropic in its action. In spite of low protein intake, the administration of this substance prevents fatty infiltration of the liver even in the presence of toxic agents such as phosphorus, carbon tetrachloride or chloroform anesthetics.

It should be realized that experiments in animals do not always coincide with clinical results found in the human but definite clinical

cal evidence demonstrates that some acute degenerative lesions of vital organs are affected beneficially by the administration of methionine. Recent investigators state that wound healing has been stimulated by its use. In addition administration of this drug has played a part in prevention of wound disruption in some protein-depleted individuals. Opinions have been expressed both for and against the use of methionine in chronic cirrhotic lesions of the liver and its value in this regard must be studied further.

Certain obstetrical patients develop complications which cause widespread liver and kidney damage. These conditions have many features relative to protein metabolism and the use of methionine which should be studied. In two recent publications<sup>1</sup> four obstetrical complications which were investigated in this regard were discussed. In patients who showed predisposition to liver damage methionine was given as a supplement to the diet or it was administered intravenously when the patients were too ill to receive it orally. Obstetrical patients suffering from the following complications were treated: patients with severe toxemia with acute infectious jaundice with hepatorenal syndrome following surgical shock and rhesus factor iso-immunized women.

Beneficial results were obtained by the use of methionine in severe pre-eclamptic and eclamptic patients. The improvement was manifested by estimations of liver function chiefly by means of the cephalin cholesterol test. Clinical improvement was evident by a striking increase in urinary output which was accompanied by diminishing edema in the majority of cases. There was no improvement in those patients who had true chronic nephritis.

Methionine and choline were given to pregnant women with acute infectious jaundice. There was no claim made that this procedure would shorten the disease as it had been demonstrated previously that immediate improvement did not occur with this treatment. However it was given with the surmise that subsequent cirrhotic changes might be prevented. The reported cases are too few and the length of study too brief to permit any conclusions.

Interesting results were obtained in cases of the hepatorenal syndrome which followed surgical or obstetrical shock. All these individuals showed persistent hypotension, anuria, coma and increasing jaundice. Liver tests denoted impaired liver function in every case. In addition to plasma and whole blood transfusions intravenous methionine was given apparently with good results.

In the last group of cases there was hemolytic disease of the newborn due to rhesus factor iso-immunization. These cases showed a most convincing effect of methionine as a hepatic protective. Studies were made of pregnant women who showed definite elevation in antibody titrations. Women with the higher antibody levels were placed on methionine every day throughout the remainder of the pregnancy. The remaining cases were used as controls; these patients did not receive the drug but treatment otherwise was identical.

The rationale in giving methionine to the mothers was that if methionine was given in sufficient quantity a good portion would cross the placental barrier into the fetal circulation. Thus it would have a possible protective action on the fetal liver. It was not claimed that methionine could prevent hemolysis of blood but it was given in an attempt to protect the fetal liver which is frequently damaged in this disease. These workers state that it is not

<sup>1</sup>MacArthur J. L. *Am. J. Obst. Gyn.* 61:3, 5 382 Philpot  
W. *Am. J. Obst. Gyn.* 64:9 57 1 5.

difficult to treat anemia but it is almost impossible to have a baby who is born with a severely damaged liver remain alive and well. The procedure used was to give methionine to the immunized pregnant women throughout the pregnancy. The babies were given smaller doses for the first twelve days of life. Liver function tests which were made on fetal blood showed far less damage when methionine was used. The fetal survival rate also was much improved.

Results have been promising but not conclusive. In the treatment of toxemia and hemolytic disease of the newborn methionine is a valuable adjunct to other proved types of therapy. The hepatorenal syndrome, which occasionally follows surgical or obstetrical shock, can be treated most efficiently by the combined administration of plasma, whole blood and intravenous methionine. The problem merits further study.

NEWELL W. PHILLIPS

# THE SURGEON'S LIBRARY

## REVIEWS OF NEW BOOKS

IN the volume *Surgical Pathology*<sup>1</sup> the author's aim is to develop a text which may serve as a useful source of information for those general surgeons or members of their allied fields by which they may have ready access to the fundamentals of pathology for active use or for preparation in the various board examinations.

The material has been carefully selected condensed, and presented without redundant verbiage. The theoretical receives little attention. Debatable subjects are discussed briefly and succinctly. There is a definite objective trend at all times. The writer describes the pathologic changes of each entity differently from other entities gives its incidence, quickly incorporates adequate clinical data and avoids prolonged discourse as to why it developed. He is more interested in the end result than in the proper book on pathology than a distillate about questionable unproved etiologic agents.

The format is simple. Without hesitation he begins by discussing the skin and ends with the bones and the joints. In other words he starts on the outside and works his way inward. There is a brief summary of embryology anatomy and histology. This reacquaints the reader with ideas which may have become dulled during the passing years. Although the rare lesions are discussed, the greater amount of space is allotted to the anatomic changes seen most frequently. Both the gross and the microscopic descriptions are complete. Where indicated, there is clinical correlation. The photographs in black and white, are well selected and appropriate. Further they are representative of the various lesions.

The print is clear and the paper smooth. There is no glare as one reads. By means of various shades and forms of type little space is lost in paragraphing and still the various divisions and sections are accentuated.

Emphasis in the bibliography is on the more recent articles and texts of the English speaking countries. In general there is an extensive amount of information provided by a writer who has had a wide experience in pathology as seen in the operating room.

This reviewer has only one suggestion to include a section on neuropathology despite the reason for deistic as given in the preface.

<sup>1</sup>*SURGICAL PATHOLOGY*. By Peter Herbut, M.D. Philadelphia: Lea & Febiger, 1948.

The book may be recommended without reservation  
M. C. WHITLOCK.

AN English translation of *Patologia da gestacao* by Raul Briquet<sup>2</sup> would be welcome. It is a thoroughly modern treatise on pathologic conditions associated with gestation. It differs from most books by presenting practically entirely current opinions and tenets. A glance at the bibliography impresses one with this fact. Seldom is there a work referred to dated before 1930 and references in the early forties are the general rule.

It is a synopsis of diseases of pregnancy written succinctly clearly understandably. Its scope is complete and no subject of importance is left unconsidered. The illustrations are good well chosen and technically the book is well done. As far as this reviewer knows there is not a similar work in the English language.

The contents may be divided into four sections. In the preliminary chapters are considerations of the migration of the ovum maturation hormones, allergies and avitaminoses. Subjects not specifically pathologic states of pregnancy are then discussed. Various diseases 19 in all, are given a chapter each. The more prominent are pulmonary tuberculosis syphilis, chronic autointoxication, acidosis alimentary liver, kidney blood and heart diseases and thropathies lower genital tract infections and trauma during gestation.

The specific pathologic states of gestation are treated under such headings as intractable vomiting hypertension, and eclampsia. The remaining chapters deal with pathologic conditions directly or indirectly associated with the ovum such as faulty implantation abortion intrauterine death hydatiform mole, and chorioepithelioma. There is appended a chapter on sterilization.

Anyone interested in reviewing pathology of pregnancy will find in this text a complete coverage of the subject set down with a modern touch.

STEPHEN A. ZIEMAN

IN the book *The Clinical Management of Varicose Veins*<sup>3</sup> the author has stressed the important factors in the clinical management and treatment of varicose veins. He agrees with most authorities that

<sup>2</sup>*PATOLOGIA DA GESTACAO*. By Raul Briquet. Sao Paulo: Editora Renascenca, S. A., 1948.  
<sup>3</sup>*THE CLINICAL MANAGEMENT OF VARICOSE VEINS*. By David Woodfolk Barrow, M.D. With foreword by Arthur W. Allen, M.D. New York: Paul B. Hoeber Inc., 1948.

varicose veins represent a degenerative condition and that the patient will have more varicose veins as time goes on regardless of what method of treatment is used.

The author has discussed very well the subjects of anatomy, physiology and pathology. Under symptomatology he has discussed in detail the subject of carbon dioxide concentration in the tissues and the association of stasis and edema with the various complications that develop in the lower leg.

In the chapter on examination of the patient he has stressed the importance of the communicating veins. He attributes his good results to careful attention to the communicating veins, and prefers to treat all extensive cases by ligation and stripping and at times with retrograde injection of the sclerosing solution. A high saphenofemoral ligation is followed by thorough stripping and subsequent mlection of the remaining vein.

Under Complications he expresses the opinion that most complications associated with varicose veins are due to the congestive factor and to the accumulation of toxic products in the tissues. Treatment is directed toward the elimination of this congestive stasis and edema. To accomplish this he carries out a careful ligation of all the perforating veins. Injection of the remaining vein which permits and supportive treatment of the extremity.

Although thrombophlebitis is not discussed as fully as the condition might warrant this volume can be recommended to any surgeon who treats and who is studying the problem of varicose veins.

H. O. McFARLANE

**THE T. Book of Genito-Urinary Surgery** by Winsbury White is the most important system of urology since Cabot's *Modern Urology* the last edition of which appeared in 1936. It is an up-to-date book written by leading British urologists. Chapters have been written by such men as Swift Joly Terence Millin, Clifford Morson, Jocelyn Swan and numerous other similarly well known urologic surgeons. Winsbury White himself has also contributed a number of chapters. The book is complete and suitable not only for the student or part time urologist, but also for the trained full time urologic surgeon. The chapters on transurethral resection describe the different instruments, the technique of their use and the results obtained with different methods. Complete chapters are also devoted to the different types of open prostatectomy including an up-to-the-year discussion by McMillin on his retro-pubic operation and a discussion on perineal prostatectomy by Winsbury White. Data on the sulfonamides and antibiotics which are complete and detailed, are not confined to a single chapter, but are spread through the book and discussed in relation to various different pathologic conditions and surgical procedures.

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A number of important, commonly occurring but rarely described, conditions are discussed thoroughly. The chapter on cystitis and associated lesions of the bladder neck is of great value and the discussion and description of bladder neck polyps and enlarged urethral glands are exceptionally clear cut and instructive. There are numerous illustrations, many in color and all good depicting surgical technique and pathologic specimens. The clarity and detail of many of the colored drawings of pathologic conditions as seen through the cystoscope are reminiscent of those seen in earlier German urologic texts.

Due to the multiplicity of subjects many conditions and procedures are necessarily dealt with rather briefly, occasionally inadequately. The book is printed with clear type on good paper and is very readable but it is bulky, difficult to handle and would fit the resting doctor's hand and tilted chair more conveniently if divided into two volumes.

The book is excellent and every urologic surgeon should have it in his library as a source of review and reference text.

A. J. SCHWARTZ

ONE cannot refrain from expressing a word of admiration on the appearance of a beautiful atlas of anatomy<sup>3</sup> coming from a country that was for so long a time under the shadow of war and devastating enemy occupation. The volume includes 512 illustrations, many of them full page and some in color depicting the osteology, the articulation and the musculature of the human body. There is no descriptive text but each illustration is carefully labelled in accordance with B.N.A. nomenclature to permit accurate and quick recognition of the structure shown.

An interesting innovation is the author's method of indicating muscle position and attachment by showing the muscles in colored diagram overlying the bony structure underneath in black and white.

This volume *Atlas of Human Anatomy* by M. W. Woerdman should prove exceedingly helpful both to the medical student working in the dissecting room and to the surgeon refreshing his memory on the details of the operative field he is planning to explore.

CHARLES L. KOCK

**THE** annual publication of the Association for Research in Nervous and Mental Disease, the 17th in the series, represents the proceedings of the Association of the December 1947 meeting. Unquestionably this rich volume *The Frontal Lobes* has a front rank position among the other distinguished Research publications of this association.

The book is divided into four sections: biology of the frontal lobes, experimental studies, clinical studies and frontal lobotomy. In each of these

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The book is well printed solidly bound well illustrated readable for all the weight of the subject matter and as usual in these publications is supplemented by an extensive cumulative bibliography.

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THE well printed and beautifully illustrated small volume *The Modern Management of Gastric and Duodenal Ulcer*<sup>1</sup> edited by Deller is designed to present to general practitioners physicians and surgeons an account of the modern trends in diagnosis and treatment of gastric and duodenal ulcer. In addition to the principal author there are five col multiple authorship this volume is decidedly uneven in quality. The chapters on the applied anatomy and physiology of the stomach and on the pathogenesis of gastric and duodenal ulcer are entirely inadequate and suggest that the authors of these sections are unaware of the large amount of experimental work that has been done in these fields during the past 25 years. While the discussion of the clinical picture of the disease is good the attempt to explain the cause of ulcer pain reveals that the author of this section is unaware of the extensive studies of W. L. Palmer and of Bonney and Pickering. The section on special investigations and radiology is good and the illustrations are uniformly excellent. By far the best parts of the little book are the sections dealing with surgical therapy. These alone make the volume a valuable addition to the library of both the internist and the surgeon. An excellent description is provided of those surgical procedures that have won a place in the treatment of this disease in the best hospitals and clinics of the world. There is also a good description and discussion of vagotomy and its place in the treatment of duodenal ulcer. The authors point out that whereas the results so far obtained by this newer method of treatment have been almost uniformly good the period of observation is still too short to permit a final conclusion with respect to its ultimate place.

LESTER R. DRAGSTEDT

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In Chapter 5 methods of employing the skin of a functionless finger the tubed flap—at times with utilization of the same flap for the repair of different and separate defects and the broad apron flap from the abdominal wall are illustrated with numerous excellent photographs many of them generously credited to the men who were carrying out these procedures in widely separated military hospitals. The importance of adequate excision of scar, of wide separation of digits and avoidance of binding scars at the webs are repeatedly emphasized both in the application of pedunculated flaps and of free grafts.

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and with clear, well conceived diagrams of operative procedures and numerous illustrations of the results obtained. A considerable amount of new material has also been added on methods of providing a substitute for the lost thumb.

The first edition of Bunnell's *Surgery of the Hand* was an outstanding contribution to surgical literature. In the second edition the author has added new material and new concepts of repairing the injured hand that should lead to definite improvement and still greater interest in the surgical management of injured hands. The entire surgical profession is indebted to him for this comprehensive study of an important and often neglected field of surgery.

SEYMOUR L. KOCHE

THE book *Practical Bacteriology, Hematology and Parasitology* needs no introduction to laboratory workers and physicians as its usefulness has been well demonstrated by a revivals since its first appearance in 1900. Each new edition has allotted more space to the interpretation and diagnostic significance of various laboratory procedures. The greatest emphasis has been placed on bacteriology, hematology and parasitology as the title indicates, however all types of laboratory work are included.

Part 1 the section on bacteriology has been almost entirely rewritten and brought up to date by Dr. Brannham who replaces Dr. Milledge Clark Clough as coeditor. It is impossible to list all the additions but a few may be mentioned such as newer laboratory methods of diagnosing diseases due to Rickettsia, filterable viruses and fungi. The chapter on mycology is well illustrated and includes a section on antibiotics. The methods of assay of penicillin in blood and the determination of the sensitivity of the organism to penicillin are given in the chapter on staining methods and special procedures.

Part 2 the section on hematology has been revised less extensively than the others. Methods for the determination of prothrombin and the Rh-Hr factors have been added, as well as the significance of the Rh factor in erythroblastosis fetalis.

Part 3 the section on parasitology has been rewritten and a great deal of new material added, including new work on malaria, schistosomiasis, filariasis, DDT and arthropod transmission of disease. There are many new illustrations especially good are those giving the life cycle of the various parasites.

Part 4, entitled *Clinical and Pathological Examination of Body Fluids and Organs*, covers a large number of subjects in relatively small space. It includes methods for the examination of urine, feces, sputum, gastric contents, cerebrospinal fluid, and the chemical examination of blood. Chapter 44 of this section on vitamins as specific food factors has a brief bibliography appended. The last section

of the appendix lists, according to diseases, laboratory procedures useful in their diagnosis.

The editors, as well as the many contributors to this book are to be congratulated on keeping this edition up to the high standards of the previous ones. This book for the many years of its existence has been a constant source of information to laboratory workers. It contains material not available in other textbooks. This edition is full of the latest work on subjects vital to the diagnosis of disease by laboratory methods.

OWEN E. HENRIK

THE book *Preoperative and Postoperative Care of the Surgical Patient* by Hugh C. Ilgenfritz has covered rather thoroughly the major developments of the war and of the past decade which have contributed most to the pronounced reduction in mortality and morbidity in surgical patients. The importance of the proper attention to nutrition, fluid and electrolyte balance and whole blood requirements before, during, and after surgery has been stressed throughout the book.

Chapters on fluid and electrolyte balance, and metabolism and nutrition constitute a concise but informative review of these important subjects.

Shock and blood transfusion are considered in separate chapters. While most of the theories as to the etiology of shock are discussed, evidence that whole blood loss is the prime etiological factor and that whole blood replacement is the chief weapon in combating shock is emphasized. Plasma and plasma substitutes are discussed and their limitations as blood substitutes are well outlined.

Sedative medications and choice of anesthetic agents are discussed in one chapter. There are chapters on general preoperative and postoperative measures.

Other chapters deal with systemic complicating factors, organic diseases, chemotherapeutic and antibiotic drugs, major and minor postoperative complications, intestinal obstruction and peritonitis, care of the wound, and burns. The latter third of the book is devoted to preoperative and postoperative care in surgery of the chest, the stomach, the small intestine and appendix, the large bowel, the biliary tract, the thyroid, the extremity and the female pelvis.

In his presentation of all these subjects the author has not limited himself to the discussion of one recommended procedure. Different methods of management are evaluated. All sides of controversial issues are presented.

Considerable attention has been given to detail, essential in the preoperative and postoperative care of surgical patients. Essential laboratory tests are described, so that with the necessary material available these tests can be performed without other reference data.

*PREOPERATIVE AND POSTOPERATIVE CARE OF SURGICAL PATIENTS.* By Hugh C. Ilgenfritz, A.B., M.D., F.A.C.S., St. Louis: The C. V. Mosby Co., 1948.

*Practical Bacteriology, Hematology, and Parasitology.* By E. R. Sitt, M.D., Ph.D., Sc.D., LL.D., Paul W. Clough, M.D., Sara E. Brannham, M.D., Ph.D., Sc.D., and contributors. 10th ed. Philadelphia: The Blakiston Co., 1948.

There is little in the book which might be criticized. Cardiorespiratory embarrassment, pentoneal contamination and sepsis are not discussed as etiological factors in shock. Perhaps not enough consideration has been given to the management of the patient who develops anuria following blood transfusion reaction, crush syndrome, and traumatic shock. The exceeding importance of limiting fluids once the anuria is known to exist, so as not to overload the circulation is not mentioned. The discussion of gas gangrene does not include diagnostic criteria for the differentiation of true gas gangrene or clostridial myositis from anaerobic cellulitis which were outlined by MacLennan, and later by Jergesen and Simeone.

These minor criticisms do not detract from the general worth of the book as a reference text on preoperative and postoperative care. The author has told not only what to do, but how to do it and why it should be done. The book can be recommended for interns residents and all practicing surgeons.

HOWARD E. SNYDER.

THE book *Successful Marriage*<sup>1</sup> is a symposium of discussions dealing with every aspect of modern marriage. The 515 page book is written by a panel of physicians, sociologists and psychologists, each an expert in his field. Dr. Fishbein and Dr. Burgess have carefully correlated the material to present an outstanding treatise on marital relationships of today. While the book is written primarily for the family, the physician who may be called upon to act as a marriage counselor will do well to familiarize himself with its contents and recommend it as authoritative reading to those who consult him about marital problems.

The book is divided into 5 parts. Part 1, entitled "Preparation for Marriage," consists of 6 chapters encompassing important advice such as the determination of true love and the wise choice of a mate. A thorough understanding of these subjects before marriage is indeed vital to marital success.

Part 2, "The Marriage," is concerned chiefly with anatomical, physiological and psychological factors in marital adjustment not generally available to the newlywed. Sexual technique and adjustment is frankly discussed and easily comprehended. A chapter on home management and finance is filled with excellent suggestions. The discourse on marital maladjustments due to psychological factors should be of great value to perplexed marital partners. It stresses the importance of seeking psychiatric advice as soon as such advice is needed and at a time when a remedy will be most easily effected. The inclusion here of an excellent chapter on miscarriage and abortion seems to be incongruous, for it belongs more correctly with the subject following.

Part 3, "Conception, Pregnancy and Childbirth," deals with heredity facts on pregnancy mechanism

of childbirth, and economic problems attendant on parenthood. There is an excellent chapter on factors favoring fertility and the basal temperature graph as an aid to conception. Contraceptive methods are also discussed.

Part 4, "The Child and the Family," includes 9 chapters pertaining to such subjects as physical and psychological growth of the child, sex problems and education and adolescent preparation for successful marriage. Since the presence of children is a dominant factor in marital happiness, the benefits of adoption are cited in instances where natural child bearing is impossible. The chapter on parent-child relationships is outstanding.

Part 5, "Social Problems of Sex and Marriage," concerns itself with social subjects a few of which are of questionable value in a book on marital success. The chapter on prostitution in the United States is one of these. Since many groups are reluctant to accept the dissolving of marriage as a solution to marital problems, the chapter on divorce is bound to be controversial.

In general, the book is frank, thorough and exceedingly well written. Practically applied the suggestions and advice set forth within this book should tend to make available the attainment of a completely happy marriage. THEODORE J. MORRIS.

FOR a practitioner with any interest in anesthesia the book *Pediatric Anesthesia*<sup>2</sup> will certainly be a well used addition to his library. The problems of pediatric anesthesia are completely discussed from the general requirements for handling children, through the preanesthetic consultation and premedication to an exhaustive, clear and stepwise discussion of techniques involved in pediatric anesthesia and finally to the postoperative care with the possible complications, how to avoid them and their treatment if necessary.

A chapter involving the special physiology of the infant is included in an effort to emphasize the particular nature of the responses of the child and new born to the administration of anesthetic drugs.

The authors are detailed in their explanations. As they state, the specialist has reached eminence by mastering detail. They leave no important consideration to chance.

In the chapter concerning inhalation anesthesia the choice of agent methods and techniques generally are reviewed. The endotracheal section is of practical importance to adult anesthesia as well since it lucidly explains methods which are certainly valid in all usage of these devices. The steps of intubation if followed will certainly facilitate smooth performance of this maneuver. The use of intravenous anesthetic agents in children is discussed and particularly valuable in this chapter is the section concerning the use of curare both as to the surgical or major relaxation effect and its aid to the anesthesiologist in reducing the induction period for

<sup>1</sup> *SUCCESSFUL MARRIAGE*. Edited by Morris Fishbein, M.D. and Ernest W. Burgess, Ph.D. Garden City N.Y. Doubleday and Co. Inc., 1945.

<sup>2</sup> *PEDIATRIC ANESTHESIA*. By M. Dierby Leich, M.D. and M. Kathleen Bellon, M.D. New York: The Macmillan Co., 1945.

intubation. The importance of adequate curarization is just as important in children as in adults. The most lengthy chapter of the book presents a dissertation of anesthetic agents and techniques which affords an excellent guide particularly for the student. This chapter list the more common surgical procedures and discusses the several anesthetic methods suitable for them. It is not dogmatic but explains

the reasons for such choice and includes examples of risk involved.

This volume does not introduce any spectacular new considerations but it does present the entire picture of the field of pediatric anesthesia and emphasizes the use of skill and judgment in the application of anesthetic drugs to any patient.

FRANCIS M. SELLERS.

## BOOKS RECEIVED

Books received are acknowledged in this department, and such acknowledgment must be regarded as sufficient return for the courtesy of the sender. Selections will be made for review in the interest of our readers and as space permit.

HANDBOOK OF SURGERY. By J. C. McEwen, M.B. Ch.B. (F.R.C.S. (Ed.)) and Ian MacKenzie, M.B. Ch.B. (F.R.C.S. (Lond.)) With Foreword by the late Sir John Fraser Bart. M.C. M.D. Ch.M. F.R.C.S. (Lond.) 2d ed. Baltimore: The Williams & Wilkins Co. 1949.

A SURGEON'S GUIDE TO LOCAL ANESTHESIA. MANUAL OF SCHOELLER'S SURG. By C. F. Corlett, M.D., Ch.M. (Sydney) F.R.C.S. Baltimore: The Williams & Wilkins Co. 1948.

OPERATIVE SURGERY. By Frederick C. Hill, B.A., M.S. (Surg.) M.D. Foreword by Charles W. Mayo, D.V., M.S. (Surg.) M.D. New York: Oxford University Press, 1949.

CARDIAC CATHETERIZATION IN CONGENITAL HEART DISEASE: A CLINICAL AND PHYSIOLOGICAL STUDY OF INFANTS AND CHILDREN. By Andre Courmand, M.D. Janet S. Baldwin, M.D. and Aaron Himmelfarb, M.D. New York: The Commonwealth Fund, 1949.

ATLAS OF ORAL AND MAXILLOFACIAL AND COLORECTAL LESIONS. By Ralph Howard Brodsky, D.M.D. Baltimore: The Williams & Wilkins Co. 1948.

DI GEBURTHSHILFELICHE OPERATIONEN. IHR AUSFÜHRUNG UND VERWENDEUNG. EIN LEHRBUCH FÜR STUDIENTEN UND GEBURTSHILFEN. VON Prof. Dr. Med. Heinrich Martinus. Stuttgart: Georg Thieme Verlag, 1948.

PHYSIOLOGICAL PHYSIOLOGY IN PRINCIPLES. LECTURES ON A HYPOTHESIS OF THE PHYSIOLOGY OF HUMAN CIRCULATION. KLINISCHE, ANATOMISCHE UND EXPERIMENTELLE BEFUNDEN. By R. Wank. Stuttgart: Georg Thieme Verlag, 1948.

LEHRBUCH DER GEBURTHSHILFE. By Prof. Dr. Med. Heinrich Martinus. Assisted by Prof. Dr. Med. Werner Bickenbach, Prof. Dr. Med. Kurt Nardemeyer and Katha Dreyer. Vol. PHYSIOLOGIE. Vol. PATHOLOGISCHE STUTTGART: Georg Thieme Verlag, 1948.

TECHNIQUE DE CHIRURGIE PELVIENNE. By R. Michel-Beebet. Paris: G. Dolé & Cie. 1948.

NOUVELLE PRATIQUE CHIRURGICALE ILLUSTRÉE. Jean Quenot, Directeur. Vol. Paris: G. Dolé & Cie. 1948.

TECHNIQUE DE LA CHIRURGIE SYMPATHIQUE ET DE SES DÉRIVÉS. By O. Lambert, P. Raimon, and P. Decoulx. 3d ed. rev. ed. Paris: G. Dolé & Cie. 1948.

VETERINARY ADMINISTRATION. THEORETICAL BELLETT. Series Vol. Washington, D.C.: Veterans Administration, 1949.

TRANSACTIONS OF THE THIRD AMERICAN CONGRESS OF OBSTETRICS AND GYNECOLOGY. Municipal Auditorium, St. Louis, Missouri, September 8-11, 1947. Edited by George W. Kresnak, M.D., and Robert N. Rutherford, M.D. Portland, Oregon: The Western Journal of Surgery Publishing Co. 1948.

CHILD HEALTH SERVICES AND PEDIATRIC EDUCATION. Report of the Committee for the Study of Child Health Services. The Academy of Pediatrics with the cooperation of the United States Public Health Service and the United States Children's Bureau. New York: The Commonwealth Fund, 1949.

CASES OF THE SURGICAL PATIENT INCLUDING PATHOLOGICAL PHYSIOLOGY AND PHYSIOLOGY OF DIABETES AND THYROID. By Jacob Lurie, M.D. Philadelphia and London: W. B. Saunders Co. 1949.

A PRIMER OF ELECTROCARDIOGRAPHY. By George E. Burch, M.D. F.A.C.P. and Travis Wilson, M.D. F.A.C.P. 2d ed. Philadelphia: Lea & Febiger, 1949.

MODERN MEDICINE 1949. AN ANNUAL VOLUME CONTAINING THE LATEST INFORMATION IN THE PRACTICE OF MODERN MEDICINE DURING 1948. Minneapolis: Modern Medicine, 1949.

PULMONARY TUBERCULOSIS, PATHOLOGY, DIAGNOSIS, MANAGEMENT AND PREVENTION. By Walter Poppel, M.D. F.A.H. Simmonds, M.A., M.D. D.P.H. N. Macdonald, M.B. M.R.C.P. (Ed.) and L. F. Hill, F.R.C.S. Revised and partly rewritten 2d ed. London, New York, and Toronto: Geoffrey Cumberlege, Oxford University Press, 1948.

BRITISH SURGICAL PRACTICE. Under the General Editorship of Sir Ernest Carling, F.R.C.S., F.R.C.P. and J. Paterson Ross, M.S. F.R.C.S. Vol. 1. London: Butterworth & Co., Ltd. St. Louis: The C.V. Mosby Co. 1948.

LES TROIS FONCTIONS DE LA PEAU. LA PEAU. LA PEAU. LA PEAU. By Gaston Cott. 3d rev. ed. Paris: Masson & Cie. 1949.

HANDBOOK OF MATERIAL MEDICA, TOXICOLOGY AND PHARMACOLOGY FOR STUDENTS AND PRACTITIONERS OF MEDICINE. By Forrest Ramon Davidson, B.A., M.Sc., Ph.D. M.B. 4th ed. St. Louis: The C.V. Mosby Co. 1949.

# CLINICAL CONGRESS OF AMERICAN COLLEGE OF SURGEONS

DALLAS B. PHEMISTER, Chicago *President*  
FREDERICK A. COLLIER, Ann Arbor Michigan *President Elect*

## PRELIMINARY PROGRAM FOR THE 35th CLINICAL CONGRESS THE STEVENS CHICAGO, OCTOBER 17 to 21, 1949

THE thirty fifth Clinical Congress of the American College of Surgeons will be held in Chicago from October 17 to 21 1949 with hotel headquarters at The Stevens. The Clinical Congress in addition to its usual five-day program will be host to the Sixth Inter American Congress of Surgery which will open on Friday morning October 21 and hold sessions through Sunday October 23. The plans for the Inter American Congress are described in a separate article.

Some twenty hospitals in the Chicago area which are approved for graduate training in surgery will participate in the clinical program. Operative and nonoperative clinics will be held in the hospitals each day in general surgery, obstetrics and gynecology, fractures, orthopedic surgery, thoracic surgery, neurosurgery, genitourinary surgery and ophthalmology and otorhinolaryngology. The schedule of clinics will be published in a *Daily Clinical Bulletin* which will be issued each day during the Congress.

Arrangements are under way to telecast operations to the hotel from one or more of the hospitals. The successful demonstrations of television at the Clinical Congress in New York in 1947 and at the Clinical Congress in Los Angeles in 1948 make it highly desirable to continue the use of this medium. Television has proved itself to be a superlative instrument to further the Show me purpose which was the main incentive for the founding of the Clinical Congress in 1910 three years before the American College of Surgeons was organized.

The program of meetings at the headquarters hotel will be varied and comprehensive. The opening session on Monday morning October 17, will be a general assembly for both surgeons and hospital personnel. Scientific sessions, official meetings and hospital conferences will follow

during the five days and many will undoubtedly wish to remain for the sessions of the Sixth Inter American Congress of Surgery on Saturday and Sunday. Delegates and visitors to the latter meeting will likewise be welcome at clinical and scientific sessions of the Clinical Congress.

### PRESIDENTIAL MEETING

The opening evening session of the Clinical Congress will be devoted to the Presidential Meeting at which the officers-elect consisting of Dr. Frederick A. Collier of Ann Arbor, president, Dr. Donald G. Tollefson of Los Angeles, first vice president, and Dr. Robert M. Moore of Galveston second vice-president will be installed. Dr. Dallas B. Phemister of Chicago, outgoing president, will preside and will deliver the Presidential Address. The fourth Martin Memorial Lecture will be delivered by Sir James R. Learmonth of Edinburgh, whose subject will be Col lateral Circulations, Natural and Artificial.

### CONVOCATION

The annual Convocation will be held on the final evening Friday. The formal initiation ceremonies for the new Fellows will be a colorful feature of the occasion. The Fellowship Address will be given by Lord Webb-Johnson of London, President of the Royal College of Surgeons.

### EVENING SCIENTIFIC SESSIONS— GENERAL SURGERY

The program and speakers for the Tuesday evening general surgery session will be as follows: Acute Surgical Emergencies in Gynecology and Obstetrics.

General Introduction. NEWELL W. PHILLPOTT  
M.D., F.A.C.S., Montreal.  
Tubal Pregnancy Its Diagnosis and Treatment  
LEWIS C. SCHREFFEL M.D. Philadelphia.

Pelvic Peritonitis Occurring in the Obstetrical or Gynecological Patient. FRANK GLENN M.D. F.A.C.S. New York.

Emergency Cesarean Section. WILLIAM E. STURDIFORD M.D. F.A.C.S. New York.

The program and speakers for the Wednesday evening general surgery session will be as follows:

Fracture Oration

Blood Coagulation and the use of Anticoagulants

The Significance of Different Methods for Prothrombin Estimation and their Relative Values. JOHN H. OLWIN M.D. Chicago

Studies on Antithrombin and Etiologic Factors in Phlebotromboses. JOHN H. KAY M.D. New Orleans.

A Further Report on Dicumarol Prophylaxis against Venous Thrombosis in Women Undergoing Surgery. GEORGE VAN S. SMITH M.D. F.A.C.S. Brookline, Massachusetts.

The program and speakers for the Thursday evening general surgery session will be as follows: Chemotherapy in Malignant Neoplastic Disease. CARL V. MOORE, M.D. St. Louis.

Hormone Therapy of Cancer. CHARLES B. HUGGINS, M.D. Chicago

The Use of Radioactive Iodine in Studying the Pathologic Physiology of Thyroid Cancer. RULON W. RAWSON M.D. New York.

What We Have Learned from Isotopes Concerning Depletion and Repair in Surgical Patients. FRANCIS D. MOORE M.D. F.A.C.S. Boston.

#### GENERAL SURGERY PANEL DISCUSSIONS

General surgery panel discussions will be held on Monday, Tuesday and Wednesday afternoons, from 1:30 to 3:00 and from 3:30 to 5:00 o'clock. The subjects and names of moderators follow:

*Monday—1:30 to 3:00 p.m.*

Surgical Lesions of the Breast. GEORGE G. FINNEY M.D. F.A.C.S. Baltimore

*3:30 to 5:00 p.m.*

Fractures of the Skull. ELDREDGE H. CAMPBELL, M.D. F.A.C.S. Albany

*Tuesday—1:30 to 3:00 p.m.*

Massive Upper Abdominal Hemorrhage. JOHN H. MULHOLLAND M.D. F.A.C.S. New York.

*3:30 to 5:00 p.m.*

New Surgical Technique in Drug Treated Infections. S. CHAMP LYONS, M.D. F.A.C.S. New Orleans.

*Wednesday—1:30 to 3:00 p.m.*

The Management of Acute Emergencies Occurring During Operations. I. MIMS GAGE, M.D. F.A.C.S. New Orleans.

*3:30 to 5:00 p.m.*

Preoperative and Postoperative Care and Anesthesia for Infants. THOMAS H. LANGMAN M.D. F.A.C.S. Boston.

#### SPECIALTY SESSIONS

Plans will be announced later for the sessions in ophthalmology, otorhinolaryngology, orthopedic surgery, plastic surgery, urology, thoracic surgery, neurological surgery, and obstetrics and gynecology. Friday afternoon will be devoted to panel discussions in the surgical specialties, but a definite schedule has not yet been completed for other sessions.

#### FORUM ON FUNDAMENTAL SURGICAL PROBLEMS

The Forum on Fundamental Surgical Problems will be held on Tuesday through Friday mornings, and from 1:30 to 3:00 o'clock on Thursday afternoon. Brief reports of original clinical and experimental observations relating to the broad aspects of surgery and the surgical specialties will be presented, under the general direction of Dr. Owen H. Wangensteen, chairman of the committee. Forum on Fundamental Surgical Problems.

#### HOSPITAL CONFERENCES

The twenty-eighth Hospital Standardization Conference will be held during the first four days of the Clinical Congress. Its opening meeting will constitute the first formal session of the Clinical Congress and will be for both surgeons and hospital representatives. Dr. Dallas B. Phenister, president of the College, will preside.

Hospital administrators, trustees, members of medical staffs, nurses, technicians, dietitians, and heads of the various hospital departments and their personnel, are invited to participate in the discussions at the hospital conferences which will be directed by leading authorities in the hospital field in the United States and Canada. The program will include formal sessions, panel discussions, round table conferences, symposia, and forums.

#### MEDICAL MOTION PICTURES

The showing of medical motion pictures each day will again be a popular feature of the Clinical Congress. The latest available films on surgery and related subjects will be presented. Special

showings will be arranged of medical motion pictures in the fields of ophthalmology and otorhinolaryngology. Both sound and silent films will be shown all of which will have been approved by the Committee on Motion Pictures. Some of the newer medical motion pictures which are now under production will be completed by the time of the Clinical Congress.

#### COMMITTEE ON ARRANGEMENTS

The Chicago Committee on Arrangements for the Clinical Congress is actively at work on arrangements for the program. The membership follows:

Warren H. Cole, M.D. F.A.C.S. Chairman  
 Michael L. Mason, M.D. F.A.C.S. Secretary  
 William E. Adams, M.D. F.A.C.S.  
 Fremont A. Chandler, M.D. F.A.C.S.  
 Edward H. Christofferson, M.D. F.A.C.S.  
 Vernon C. David, M.D. F.A.C.S.  
 M. Edward Davis, M.D. F.A.C.S.  
 Loyal Davis, M.D. F.A.C.S.  
 Lester R. Dragstedt, M.D. F.A.C.S.  
 Paul W. Greeley, M.D. F.A.C.S.  
 Paul H. Holinger, M.D. F.A.C.S.  
 Sumner L. Koch, M.D. F.A.C.S.  
 Herman L. Kretschmer, M.D. F.A.C.S.  
 Walter G. Maddock, M.D. F.A.C.S.  
 Foster L. McMillan, M.D. F.A.C.S.  
 Karl A. Meyer, M.D. F.A.C.S.  
 Harry A. Oberhelman, M.D. F.A.C.S.  
 Dallas B. Phemister, M.D., F.A.C.S.  
 Willis J. Potts, M.D. F.A.C.S.  
 Charles B. Puestow, M.D. F.A.C.S.  
 Herbert E. Schmutz, M.D. F.A.C.S.  
 Derrick T. Vail, M.D., F.A.C.S.

The Clinical Congress general committee which operates under the Administrative Board of the College, consists of Dr. Malcolm T. MacEachern, chairman, Miss Eleanor K. Grimm, secretary, Doctors Bowman C. Crowell, Charles F. Branch, George H. Miller and H. Prather Saunders, and Mr. Edward G. Sandrock, Mr. James S. Shannon and Miss Laura G. Jackson.

The Clinical Congress Committee on Programs consists of Dr. Frederick A. Collier, chairman and Doctors Henry W. Cave, Evarts A. Graham, and Alton Ochsner.

The Advisory Committee on Programs consists of Dr. George H. Miller, chairman and Doctors Warren Cole, Sumner Koch, Michael Mason,

Charles Puestow, Bowman C. Crowell, H. Prather Saunders, Charles F. Branch and Malcolm T. MacEachern.

#### TECHNICAL AND SCIENTIFIC EXHIBITION

The Technical and Scientific Exhibits will be held in the Exhibition Hall on the lower level of The Stevens. Leading manufacturers of surgical instruments, x-ray apparatus, sterilizers, operating room lights, ligatures, dressings, hospital apparatus and supplies of all kinds, and pharmaceuticals, and publishers of medical books will be represented.

#### ADVANCE REGISTRATION

Surgeons who wish to attend the Congress should register in advance. Advance registration will greatly expedite the procedure of registering. No registration fee will be charged. Fellows whose dues are paid to December 31, 1948. For endorsed Junior and Senior Candidates, the fee will be \$5.00. Non-Fellows who after individual consideration are permitted to register will pay a fee of \$10.00. No registration fee will be required of initiates of the class of 1949.

#### HOTEL RESERVATIONS

It is desirable to make hotel reservations as early as possible. In making these communications should be addressed to the Convention Housing Bureau, 105 West Adams Street, Chicago, stating that you will be attending the Clinical Congress of the American College of Surgeons. All hotel reservations, both for surgeons and hospital representatives are to clear through this Bureau. No correspondence should be sent directly to the hotels. A form for reservations was enclosed in the letter recently sent to Fellows. Choice of hotels may be designated.

A list of the major hotels follows:

#### CHICAGO HOTELS

Blamark, 171 W. Randolph Street  
 Blackstone, Michigan Avenue at 7th Street  
 Congress, 500 S. Michigan Avenue  
 Drake, Michigan and Lake Shore Drive  
 Harrison, 57 E. Harrison Street  
 Lake Shore Drive, 181 Lake Shore Drive  
 LaSalle, 10 N. LaSalle Street  
 Morrison, 79 W. Madison Street  
 Palmer House, 15 E. Monroe Street  
 Sheraton, 505 N. Michigan Avenue  
 Sherman, 106 W. Randolph Street  
 Stevens, 720 S. Michigan Avenue





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 M. Edward Davis, M.D. F.A.C.S.  
 Loyal Davis, M.D., F.A.C.S.  
 Lester R. Dragstedt, M.D. F.A.C.S.  
 Paul W. Greeley, M.D. F.A.C.S.  
 Paul H. Holinger, M.D. F.A.C.S.  
 Sumner L. Koch, M.D. F.A.C.S.  
 Herman L. Kretschmer, M.D. F.A.C.S.  
 Walter G. Maddock, M.D. F.A.C.S.  
 Foster L. McMillan, M.D. F.A.C.S.  
 Karl A. Meyer, M.D. F.A.C.S.  
 Harry A. Oberhelman, M.D. F.A.C.S.  
 Dallas B. Phenuster, M.D. F.A.C.S.  
 Willis J. Potts, M.D., F.A.C.S.  
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Surgeons who wish to attend the Congress should register in advance. Advance registration will greatly expedite the procedure of registering. No registration fee will be charged. Fellows whose dues are paid to December 31, 1948. For endorsed Junior and Senior Candidates, the fee will be \$5.00. Non-Fellows who after individual consideration are permitted to register will pay a fee of \$10.00. No registration fee will be required of initiates of the class of 1949.

#### HOTEL RESERVATIONS

It is desirable to make hotel reservations as early as possible. In making these, communications should be addressed to the Convention Housing Bureau, 205 West Adams Street, Chicago, stating that you will be attending the Clinical Congress of the American College of Surgeons. All hotel reservations, both for surgeons and hospital representatives are to clear through this Bureau. No correspondence should be sent directly to the hotels. A form for reservations was enclosed in the letter recently sent to Fellows. Choice of hotels may be designated.

A list of the major hotels follows:

#### CHICAGO HOTELS

Bismarck, 111 W. Randolph Street  
 Blackstone, Michigan Avenue at 7th Street  
 Congress, 500 S. Michigan Avenue  
 Drake, Michigan and Lake Shore Drive  
 Harrison, 57 E. Harrison Street  
 Lake Shore Drive, 181 Lake Shore Drive  
 LaSalle, 10 N. LaSalle Street  
 Morrison, 79 W. Madison Street  
 Palmer House, 15 E. Monroe Street  
 Sheraton, 505 N. Michigan Avenue  
 Sherman, 100 W. Randolph Street  
 Stevens, 750 S. Michigan Avenue

## SIXTH INTER AMERICAN CONGRESS OF SURGERY

**T**HE thirty fifth Clinical Congress of the American College of Surgeons will be host to the sixth Inter American Congress of Surgery when it convenes in Chicago on October 21, 22 and 23. On its first day it will overlap with the Clinical Congress. The delegates and visitors from Latin American countries will be welcome to attend all sessions of the Clinical Congress, and the operative clinics at the hospitals.

The American College of Surgeons joined the Association of Inter-American Congresses of Surgery by vote of the Board of Regents on June 27, 1944. This action was preceded by an invitation from Dr. Luis Vargas Salcedo of Santiago, Chile, dated July 21, 1942, to send two delegates as guests of honor to the first Inter American Congress of Surgery in Santiago held November 14 to 19, 1942. Dr. Leo Eloesser attended as delegate, and it was upon his enthusiastic recommendation that the College accepted the invitation to join. He also attended the second Congress held in Buenos Aires, October 10 to 15, 1943. Dr. Alton Ochsner was delegate to the third Congress, held in Rio de Janeiro from September 6 to 15, 1947. The fifth Congress was held in La Paz, Bolivia, October 17 to 21, 1948, with Dr. E. Payne Palmer of Phoenix and Dr. Hu Crim Myers of Philippi, West Virginia as delegates and co-relators.

The surgical societies of the following countries, in addition to the United States, are members of the Association of Inter American Congresses of Surgery: Argentina, Brazil, Bolivia, Chile, Cuba, Ecuador, Mexico, Panama, Paraguay, Peru, and

Uruguay. Dr. Arnaldo Cavaglia of Buenos Aires is the Secretary General.

A preliminary outline of the program for the Sixth Inter American Congress of Surgery follows:

*Friday morning, October 21*

Inaugural Ceremony

*Friday afternoon, October 21*

Delegates may attend the specialty panels of the Clinical Congress

*Saturday morning, October 22*

Main Theme: Acute Craniocerebral Trauma

Relator: E. Jefferson Browder, M.D.

F.A.C.S. Brooklyn

Co-relators: To be appointed by each country

*Saturday afternoon, October 22*

Main Theme: Treatment of Injuries in the Region

of the Ankle with Complications and Sequelae

Relator: Harrison L. McLaughlin, M.D.,

F.A.C.S. New York

Co-relators: To be appointed by each country

*Saturday evening, October 22*

Official Banquet

*Sunday morning, October 23*

Business Session

*Sunday afternoon, October 23*

Main Theme: Pulmonary Carcinoma

Relator: E. Everts Graham, M.D., F.A.C.S.,

St. Louis

Co-relators: To be appointed by each country

# SURGERY GYNECOLOGY AND OBSTETRICS

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# INTERNATIONAL ABSTRACTS OF SURGERY

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## COLLECTIVE REVIEW

### PROTEIN METABOLIC RESPONSE TO TRAUMA

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WITHIN the last few years, Selye (91, 92) Cuthbertson (21, 23, 24, 25) and others have done much to focus the attention of not a few investigators on the important problem of the protein metabolic response to trauma. Some workers have approached this problem hoping to use its elucidation as a key to the workings of various endocrine problems, and others have hoped that some practical application to the treatment of various traumatic states might be found. The latter have been disappointed the former have not. Through these efforts we are now on the threshold of uncovering many of the mechanisms involved.

The importance of this problem has not been overemphasized. When one considers the part protein plays in edema formation, wound healing, gastrointestinal function, gastric and duodenal ulcers, epidermal ulcers, surgical traumatic, and burn shock, resistance to infection, and liver damage as has been recently outlined by Kremen, one is impressed with the strategic nature of the subject under scrutiny.

It is the writer's purpose in this article to review the field pertaining to the changes in protein metabolism incident to nonspecific damage, to discuss the possible etiology of such changes, and to bring in any other relevant material. In so doing it is hoped that some of the confusion surrounding this subject will be clarified.

To avoid the confusion which might arise in the description of these metabolic changes, each tra-

umatic situation will be reviewed separately. It is considered important by this worker that these separate entities be thought of as such until more definite evidence is discovered which allows them to be included in one syndrome.

**Fractures.** Cuthbertson credited Wertheimer *et al.* with making the first studies on this phenomenon. These workers found high urinary nitrogen excretion levels following battle injuries and shock. Cuthbertson (21, 23, 24) was the first worker to make extensive studies on the protein metabolic response to fracture. He found that the urinary nonprotein nitrogen was increased after fracture, remaining elevated for periods up to 30 days. Howard *et al.* (48, 50, 51) confirmed and extended Cuthbertson's observations, demonstrating that following osteotomy patients excreted an increased amount of nitrogen in the urine, but the increase was not of the same magnitude or duration as that following traumatic fracture. In addition, fecal nitrogen levels were found to bear no constant relation to the stage of the reaction to fracture. As to any correlation between the amount of trauma and the height of increase in urinary nonprotein nitrogen, there seems to be some confusion. In 1936, referring to patients, Cuthbertson (23) stated that the loss of nitrogen in the urine varied with the amount of soft part injury incident to the fracture, but in 1942, referring to experimental studies in rats, he (24) stated that there was apparently no correlation between the amount of trauma and the amount of nitrogen lost.

Partition studies of the nitrogen fractions of urine by Cuthbertson (23, 24) revealed that most of the increase was in urea and ammonia with a slight increase in the creatine fraction. Concom-

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Itantly the excretion of sulfur potassium, and phosphate was found to follow roughly the nitrogen excretion.

There is some disagreement in the literature regarding the efficacy of high protein or high caloric diets, or of both, for establishing a positive nitrogen balance after fracture. Cuthbertson (23) found that giving a large amount of protein (up to 33 gm. of nitrogen a day) and a moderate number of calories (up to 2,400 calories a day) did not appreciably affect the negative balance as the extra nitrogen administered appeared in the urine. On other occasions he administered up to 4,100 calories, but still the negative nitrogen balance persisted. Howard *et al* (48, 50, 51) and Browne (9, 10, 11) are of the same opinion. Opposed to these views is Werner who cited a case of fractured femur with multiple soft part injuries. The patient's course after fracture was marked by a positive nitrogen balance throughout on from 21 to 53 gm. of nitrogen daily administered orally and intravenously in the form of amino acids and amigens. This worker failed, however to mention the patient's previous dietary history which as we shall point out later is of vital importance.

The urinary excretion of cortinlike substances and 17-ketosteroids has been studied by Browne *et al* (8, 9, 10, 11, 12, 13). Unfortunately their cases yield no definite information because some of them are complicated by intercurrent infection, isolated determinations, fluctuating intakes, mixed types of trauma, and other factors. However the following generalities can be drawn from this work and that of Forbes *et al* (1) after fractures and other types of trauma the urinary 17-ketosteroid output is raised for from 24 to 48 hours, then it falls below normal for a period approximating the "catabolic reaction" and (2) the urinary excretion of the cortinlike substances appears to be increased for this same quite variable length of time. No definite inferences as to a correlation between the return to normal of these substances and the return to normal levels of the nitrogen excretion can be drawn.

This metabolic response which has just been described can be reproduced in the rat. Cuthbertson *et al* (25) studied the urinary nonprotein nitrogen, creatinine, creatine, sulfur sodium, potassium, and phosphorus from adult rats after fracture of the femur at open operation. They found that the sodium and creatinine levels remained fairly constant, but those of nitrogen, sulfur potassium, and phosphorus were increased. This response lasted 6 days with a peak on the third day. It is interesting to note that some of the animals were given extra carbohydrate in their diets, and

It was the authors' opinion that their nitrogen loss was not as great.

**BURNS.** Turning our attention now to the effects of thermal injury we find that this type of damage is followed by the same consequences as fracture with one or two exceptions. Davidson was the first worker to notice that the total urinary nitrogen excretion was elevated after burns. Lucido followed the nitrogen excretion in a single case of 40 to 50 per cent third degree burn and found that the urinary nitrogen excretion remained elevated for approximately 30 days. Taylor *et al* (95) studied these chemical phenomena extensively in patients and found an increase in urinary nonprotein nitrogen for a period corresponding to the severity of the burn, from 14 to 21 days. Urinary nitrogen partition studies revealed a relative and absolute increase in the undetermined nitrogen fraction. These authors surmised that this fraction was made up of polypeptide nitrogen as it yielded both amino and amide nitrogen. This undetermined nitrogen fraction remained elevated for as long as the study continued in the data presented. The patients on whom the urinary partition studies were made were severely burned, showing hemoglobinuria and suppression of urine formation. In fact, the total nitrogen in the urine of the patients whose data were presented ranged from normal to high normal. However no data on the intake were given therefore the significance of the last statement is open to question. The remaining components of the total urinary nitrogen were normal with the exception of the presence of small amounts of creatine. Plasma nitrogen partitions were found to mirror those of the urine. Ilshfield *et al* and Abbott *et al* confirmed the work of Taylor *et al* (95) in so far as the increase in total urinary nonprotein nitrogen was concerned. They however were unable to demonstrate any appreciable increase in the undetermined nitrogen fraction. On the other hand Walker *et al* studying urinary and plasma nitrogen partitions following severe burns were able to confirm Taylor's finding relative to the undetermined nitrogen. They also showed that the urinary creatinine contributed moderately and the creatine minimally to the rise in urinary nonprotein nitrogen. The ureic acid fraction remained relatively constant.

As in the case of fractures, there is not complete unanimity of opinion as to the constancy of the phenomenon under discussion. For Cope *et al* found, following burns, only a small negative nitrogen balance which "was easily correctible by increasing the protein and caloric intake. Electrolyte studies also revealed a constantly positive

potassium and phosphate balance. These authors surmised that the discrepancy between their work and the studies of other workers was on the basis of the absence of infection in their series. It occurs to the writer that this difference might be explained by the extent of the burns. Cope's patients were victims of the Coconut Grove fire and suffered mainly from inhalation burns. Examination of the protocols reveals that the patients with extensive surface burns, as a rule, lost from 20 to 30 gm. of nitrogen a day in the urine. The balance in these cases became positive only after 10 or 12 days with nitrogen intakes of approximately 20 gm. The writer has no explanation for the positive electrolyte balances.

Urinary cortinlike substances and 17 ketosteroids have been studied after burns as well as after fractures. Cope *et al* found the 17 ketosteroid excretion to be raised for from 3 to 7 days after burns, then subnormal until the end of convalescence. Forbes *et al* confirmed these observations as did Brown *et al* (8 9 10 11 12 13). The latter workers found the sequence of events in urinary cortinlike substance excretion the same after burns as after fractures. Usually as pointed out after fracture, the urinary excretion level of this substance returned to normal approximately with the nitrogen balance. However these authors described some cases in which the cortinlike substance remained elevated in the urine long after nitrogen equilibrium was attained under the dietary factors described.

The important problem of nutrition as it relates to the urinary nitrogen excretion after burns has been investigated by Taylor *et al* (96). He found that 3 000 calories and from 100 to 125 gm. of protein per day were often necessary to correct the negative nitrogen balance in their burn patients. These findings were confirmed by Abbott *et al*.

Experimental burns have yielded much the same information as have the clinical studies. Meyer *et al* (75) using dogs found a negative nitrogen balance lasting 15 days after the burn on diets similar to those of the control period. They noted a rise in urinary nitrogen without change in the urinary nitrogen partition and without change in the total fecal nitrogen. These findings were generally substantiated by Clark *et al* in rabbits. However in these animals the percentage of ammonia and creatinine remained constant but that of urea as well as of creatine was increased. No increase in undetermined nitrogen was found.

Clark *et al* studied the blood urea concentration after burns in rats and rabbits and found as would be expected, that it was elevated. These observations were confirmed and extended by Rosenthal

*et al* who found that in the case of burns of 50 per cent lethality there was only a slight rise in the undetermined nitrogen fraction comparable to the rise in the amino nitrogen fraction which returned almost to normal levels in 12 to 16 hours after the burn. On the other hand burns of 100 per cent lethality caused markedly increased undetermined nitrogen values in the blood. The amino nitrogen levels were elevated but to a minor degree. Both changes persisted until death after 12 to 16 hours.

*Other forms of trauma* The forms of trauma giving the metabolic response of greatest magnitude are burns and fractures but it is well recognized that operative procedures, soft part injuries (12) bedrest (27) infections (41) and other surgical or medical conditions may under certain circumstances produce much the same metabolic events as do burns and fractures.

Brunschwig *et al* (14) and Brunschwig and Corbin (15) extensively studied postoperative nitrogen excretion. During the immediate postoperative period the giving of intravenous nitrogen in amounts which before operation would be sufficient to maintain a positive nitrogen balance, was found usually to result in a negative balance. These authors noted further that as a rule the patients who were subjected to the most extensive operative procedures showed the larger loss of nitrogen in the urine per unit of nitrogen intake.

The work of Werner and of Mulholland *et al* is not in agreement with the previous statements. The former worker presented the data on 8 cases and referred to 17 others, mostly intra abdominal operations. Of 2 partial gastrectomy patients on whom complete nitrogen excretion data were presented one showed a positive balance on nitrogen intakes which in the normal subject would just be sufficient to maintain nitrogen equilibrium. The other patient showed a negative balance with a high urinary nitrogen excretion. Werner concluded that with a sufficient intake of protein the nitrogen balance can be kept positive throughout the immediate postoperative period. It is the writer's belief that this conclusion cannot be drawn from the inadequate evidence presented. Then too the lack of preoperative evaluation of the patient's nutritional status is an important omission in the light of the observation of Browne *et al* (11) regarding the failure of the catabolic response in debilitated individuals. The latter workers, Mulholland *et al* report the maintenance of a positive nitrogen balance after partial gastrectomy with oral alimentation. Again these patients were subjected to partial gastrectomy for peptic ulcer. In view of the fact that their nutri-

tional status was unknown, and considering the marked individuality in response to trauma, the significance of the 4 cases presented is in doubt.

Well and Browne and Venning *et al* (98, 99) have shown that, as after burns and fractures, the excretion of cortinlike material in the urine is increased after surgical procedures. A peak is reached at the third to fifth day and following this the excretion gradually declines to normal values. According to Forbes *et al* the 17 ketosteroid output also follows the general pattern found in the previously described traumatic conditions.

#### COMMENT

Before comment is made on the concepts herein presented the shortcomings of the present methods of studying protein metabolism should be discussed. Clinical investigations have been carried out with emphasis on the nitrogen balance, and by means of urinary partition studies, plasma nitrogen concentrations, electrolyte balance studies, and hormone metabolic excretion levels. Therefore, it should be recognized that the knowledge gained thereby is of limited value and interpretations as to the actual tissue nitrogen metabolism may be too deviously drawn. The fact that these same methods, with the emphasis distributed in the same way are relied upon quite extensively in the laboratory investigation of the phenomena in question forces one to accept the conclusions derived therefrom with the same qualifications.

Largely through the efforts of Cathbertson are we acquainted with the sequelae of major fractures. Cathbertson has shown in patients and experimental animals, an increase of urinary nitrogen, sulfur, potassium, and phosphorus, the nitrogen increase being due mainly to an increased urea fraction. Accompanying these changes, but without the establishment of a definite correlation, is an increase in the urinary excretion of cortinlike substance and a brief increase followed by a rapid drop to subnormal, of the 17 ketosteroid urinary output. There appears to be some disagreement as to the efficacy of a large amount of protein with or without a high caloric diet, in returning the nitrogen balance to positive, but there is definite agreement that after a major trauma such as a severe burn, raising the nitrogen intake to approximately 25 gm. daily with a comparable caloric increase does not alter the over-all balance to a significant degree.

The metabolic results of thermal burns with a few exceptions are similar to those following fracture. In the experimental animal the response to burning is more marked and more prolonged than

that to fracture. In the only electrolyte study after burn no negative balance was noted, and some of the investigators noted a brief rise of the undetermined nitrogen fraction in the urine and blood. After uncomplicated surgical procedures and other miscellaneous damaging stimuli, the over-all nitrogen balance is similar to that following burns and fractures, as is the urinary excretion of cortinlike substance and 17-ketosteroids.

One of the more important factors controlling the metabolic changes after damage is obviously the extent of the damage. An equally important influence is the nutritional state of the individual at the time of the trauma. The debilitated individual has been noted by Browne *et al.* (12) to be much different in his response to trauma, burns, fractures, and surgical procedures from the normal. These workers have failed to obtain rises in urinary nonprotein nitrogen following damage in these cases. This phenomenon has been noted in experimental animals on low protein diets by Munro and Cathbertson, Cohen and Browne, and Madden and Clay. In addition to failing to show the increase in urinary nonprotein nitrogen, these individuals do not have an increased urinary cortinlike substance excretion in response to damage (9).

The implications of these metabolic phenomena are far from clear. The prevailing opinion is that the reaction is concerned with the transport of proteins and minerals from elsewhere in the body to the wound or any other area in need of protoplasmic building blocks. However if this reaction is prolonged it leads to protein depletion with all its consequences. This opinion is based on a rather insecure foundation. Sanders and Garrison placed adult rats on a 1 per cent protein diet for from 10 to 13 days before producing an abdominal wound and beginning sodium ricinoleate administration intramuscularly. This agent is an irritant producing an increase in urinary nonprotein nitrogen in normal rats and, theoretically, the reaction described for burns and fractures. These authors found that the experimental animals had wounds of higher tensile strength after the fifth postoperative day. They did not determine the urinary nonprotein nitrogen levels. It has been shown that a period of low protein feeding prevents the protein metabolic response to damage; therefore, their results are invalidated. Ravdin *et al.* found that sodium xanthine and other irritants producing the so-called catabolic reaction protected rats from injury by chloroform. They postulated that the split protein products set free from tissue by the irritant protected the liver cells from the chloroform damage.

It has been suggested that the body initiated a generalized catabolism to provide the wounded area with some missing substance found in low concentrations in normal tissue. In other words, there existed a relative deficiency at the site of the damage. Accordingly Croft and Peters supplied rats with added amounts of methionine in their diets after scalds and failed to find the usual increase in total urinary nitrogen. However Meyer *et al* (74) using dogs, and Chanutin and Ludewig using rats, have attempted to repeat these studies without success.

A further important practical consideration concerns itself with the use of high protein diets following burns and other trauma. If this additional nitrogen is excreted almost quantitatively in the urine, its value is open to question. Using the method of self-selection feeding in rats during infection and after burns Holt and Kayda have shown that the animals tended to avoid protein food while suffering from the depressing effects of the infection. With recovery they tended to eat a higher protein diet than normally. These workers also mentioned work with burns using this same method. Immediately after the burning the rats usually chose a high protein diet.

This conflicting evidence is not particularly clarifying and until new methods are developed to study this enigma its solution will remain obscure. Until this time comes, it is the consensus that tested methods of clinical management should prevail.

#### PATHOGENESIS

Within the last several years the writings of Selye (91, 92) have provided much of the impetus behind the attempt at elucidation of these phenomena. He has combined and integrated much previous work and added some of his own to formulate a concept concerning a response to nonspecific trauma which he calls the "adaptation syndrome." This syndrome concerns itself with the development of a resistance to various damaging stimuli and the various underlying chemical and structural alterations taking place. The protein metabolic response to damage is included by Selye in the adaptation syndrome as but a small part of it. It is largely through his influence that the eyes of investigators in this field have been focused on the endocrines in general and on the adrenal gland in particular as playing a part in the etiology of the nitrogen metabolic response to trauma. However before we examine the evidence concerning the role of the adrenal and other endocrine glands, it behooves us to deal with the nonendocrine aspects of the problem.

*Source of nitrogen.* Cuthbertson *et al* (25) wondered at the source of the nitrogen lost after trauma. He studied the response in rats after fracture and found that the changes in weight of the quadriceps of the injured limb did not account for the total loss in protein as represented by the excessive nitrogen excreted in the urine. To attempt to elucidate the problem further he also studied the sulfur, phosphorus, and potassium balance in the same group of animals. He found that the ratio of excess sulfur and phosphorus to excess nitrogen in the urine was approximately that found in muscle tissue. It was his impression that the potassium to nitrogen ratio was higher than that of muscle tissue which discrepancy he explained by postulating a change in cell permeability related to the healing process. He based this supposition on the work of Andresen and Tammarn who found an increase of the potassium concentration in the tissue fluids of aseptic wounds.

Further work has not particularly clarified the situation. Howard (47, 48, 49) studied potassium and nitrogen balances following abdominal operations, hypophyseal procedures, fever from malarial inoculations, and fractures. He could not demonstrate a correlation between the potassium to nitrogen ratio in muscle and the ratio of excess potassium to excess nitrogen in the urine following these procedures. In 1943 Alhright stated that the potassium, sulfur, and phosphorus to nitrogen urinary ratios approximated that of normal muscle tissue during the first and second half of fasting or following thyroxine administration. But in 1945 Reifstein *et al* found that the calculated potassium balance on the basis of the nitrogen balance did not agree with the actual balance after operative trauma. They postulated this discrepancy to be due to an error in calculating the nitrogen to potassium ratio of muscle tissue or a difference in the nitrogen to potassium ratio of catabolized tissue as compared with anabolized tissue.

The inference gathered from this work, although conflicting at times, seems to point to the general body protein stores as the source of the excess nitrogen excreted following nonspecific damage.

*Influence of adrenal cortex.* As stated previously, the work of Selye (92) has pointed to the endocrine glands as playing an important part in the response to nonspecific trauma. This worker showed that in response to damage there was hypertrophy of the adrenal glands, atrophy of the thymus and lymph nodes, a set pattern of blood chemistry and electrolyte changes, and changes in the specific and nonspecific resistance to the trauma. These changes were not reproducible in the adrenalectomized or hypophysectomized animal.

These observations suggest a relationship on a pathogenetic basis of the protein metabolic response to damage to the foregoing observed changes.

This concept is especially pertinent in the light of the influence of the adrenal gland on protein metabolism. Britton and Silvette were among the first workers to demonstrate metabolic abnormalities following adrenalectomy finding low blood and tissue carbohydrate levels after this procedure. Evans found that fasting phlorhizinized adrenalectomized rats without treatment excreted 25 per cent less nitrogen than did normal rats under similar conditions. This observation has since been confirmed by Harrison and Long without the use of phlorhizin.

As a corollary to these findings, Long *et al* (67) showed that adrenocortical extracts increased the glycogen content of the liver, the urinary sugar and the glycogen of the body fluids with a concomitant increase in urinary nitrogen either in normal or adrenalectomized animals. These same workers failed to increase the nitrogen excretion in the urine of partially pancreatectomized animals on a 53 per cent protein and 11 per cent carbohydrate diet with 10 c.c. of cortical extract or 313 mgm. of corticosterone. Ingle (52, 54, 57) has investigated the results of 17-hydroxy 11-dehydrocorticosterone, 17-hydroxycorticosterone and corticosterone administration to rats. All of these compounds, if given in sufficient doses, were capable of inducing a glycosuria and an increase in nitrogen excretion. In the case of 17-hydroxy 11-dehydrocorticosterone the increase in nitrogen excretion did not appear to be sustained.

In a review by Long (64) of the possible focus of action on protein metabolism of the cortical hormones, most of the evidence came from tissue slice studies. Among these was the demonstration by Jimenez Diaz of lower rates of deamination in the kidneys of adrenalectomized rats. Fraenkel-Conrat *et al* (38) have noted a decreased liver arginase concentration in adrenalectomized rats which was restored to normal by corticosterone, 11-dehydrocorticosterone and 11-dehydro 17-hydroxycorticosterone. These compounds were found also to increase the arginase content of livers in normal rats. The same workers (39) have demonstrated that hypophysectomy leads to a marked decrease in liver arginase, and that adrenocorticotrophic hormone reverses this change.

This considerable amount of evidence implicates the adrenal cortex and its secretions as being partially responsible for the control of protein metabolism and the excretion level of urinary nonprotein nitrogen. This control remains to be proved especially in the light of the following evidence.

It was shown by Wells and Kendall (102) that phlorhizinized rats developed a lower urinary sugar output when adrenalectomized. However, these same rats were able to utilize fed casein to maintain a stable glucose urinary output after adrenalectomy. These workers suggested the possibility of differential control of the metabolism of food and body proteins. Ingle and Oberle (55) found that force-fed and fasted, saline-treated, adrenalectomized rats excreted as much nitrogen in the urine as did controls. They postulated that the rat has mechanisms regulating nitrogen balance other than the adrenocortical hormones and that adjustment in the metabolism of proteins can occur without the adrenals. These results are not contradictory to those of Evans or Harrison and Long as their animals were not allowed access to saline.

Sayers and Sayers *et al* (88) have shown that the rat's adrenal cholesterol content is lowered and then rises in response to injection of the adrenocortical hormone of the anterior pituitary. The same response curve was noted after damage to the organism such as exposure to a cold environment. Exposure to low barometric pressures (63) the injection of B chloroethyl vesicants (69) and hemorrhage (90) were followed by the same response which was abolished by hypophysectomy. Furthermore, the same changes were found in the ascorbic acid content of the adrenal gland (70, 89, 90). Following hypophysectomy the total adrenal cholesterol is lowered, but not the concentration (Sayers *et al* 88). In all of these papers the lowering of adrenal cholesterol and ascorbic acid with subsequent increase was interpreted first as depletion of the original reserves and subsequent increased formation by the hyperactive gland. Sayers and Sayers *et al* (88) correlated these chemical studies with the histochemical appearance of the adrenal gland, suggesting that the ascorbic acid and cholesterol curves were compatible with the change in amount of lipid-staining substances in the adrenal cortex.

The recent development by Talbot *et al* of a colorimetric, quantitative test for the 11-oxy corticosteroids has provided Hemphill and Reis with a technique with which to measure the 11-oxy corticosteroid level of the adrenal tissue and blood. These workers followed the adrenal and blood content of these substances in rats after adrenocorticotrophic hormone administration and after exposure to cold. After the injection of adrenocorticotrophic hormone they found a transient decrease followed by a steady increase in the adrenal content and a steady increase without decrease in the blood. In the case of cold exposure the adrenal

content did not decrease but increased steadily for 72 hours. These results are compatible with those of the vitamin C, cholesterol and histochemical studies previously mentioned.

The control of the adrenal gland is therefore exercised by the anterior pituitary gland through its elaboration of the adrenocorticotrophic principle. Ingle *et al* (54) have produced an atrophy of the adrenal cortex by the continued administration of cortical extract. These same workers showed that the administration of adrenocorticotrophic hormone prevented this same atrophy. Furthermore, the usual adrenal hypertrophy was not found following 12 hours of exercise as a stressing agent if cortical extract was given previous to these observations, showing that pretreatment with corticosterone prevents the usual fall in adrenal ascorbic acid and cholesterol of rats exposed to cold or subjected to unilateral adrenal ectomy. They postulate that exposure to stress increases the tissue utilization of cortical hormone lowering its level in the blood which in turn brings about activation of the anterior lobe of the pituitary gland.

Long and Fry (66) and Long (65) have recently presented evidence concerning the control of this system by epinephrine. These workers found that the intramuscular injection of this agent into rats caused a decrease in adrenal ascorbic acid in the normal but not in the hypophysectomized animal. A just criticism of the assumption that epinephrine might play a part in the metabolic response to damage is the fact that this drug may be just another nonspecific agent. In answer to this criticism Long (65) points out that recently it has been demonstrated that administration of the drug increased the height of thyroid epithelium (82) increased the blood level of thyrotrophic hormone in normal dogs (93) and rabbits, it caused ovulation in a significant number of animals (72).

In the preceding papers we have seen the thesis developed that the adrenocortical hormones are intimately concerned with nitrogen metabolism and that the administration of these hormones in excessive amounts can cause an increase in urinary nonprotein nitrogen. Evidence has been cited showing that certain changes take place in the adrenal cortex following the exposure of the organ to a damaging situation and the mechanisms involved in controlling these changes have been reviewed.

Recently however there has been published some evidence which tends to make the foregoing

speculations rather insecure. Tohy and Nohle and Ingle *et al* (58) studied the response to limb clamping and fractures in adrenalectomized rats. These animals failed to show the expected rise in urinary nonprotein nitrogen following trauma but if they were given a constant dose of cortical extract which in itself failed to increase nitrogen excretion the rise in urinary nonprotein nitrogen occurred. The adrenal glands, therefore seem to be necessary for the mechanism to function but it can go on without an increased secretion from them because in the animals whose adrenals were replaced by a constant parenteral dose of cortical extract trauma was attended by the usual consequences in nitrogen excretion.

*Role of the thyroid gland.* The action of the secretions of the thyroid on the urinary nitrogen excretion are familiar namely an increase in nitrogen excretion follows the administration of thyroxine. Wells and Kendall (103) from studies on phlorhizated and adrenalectomized thyroidectomized rats, were under the impression that the adrenal cortex and thyroid acted synergistically in their control of nitrogen excretion. The pioneer studies of Dougherty and White (28) have been most informative. These workers demonstrated that mice caused a regression of lymphoid tissue. Since then they (29, 30) have demonstrated the control of circulating lymphocytes and antibody titer exhibited by the adrenal cortex and the corticotrophic hormone of the anterior pituitary. Recently they (106) have added greatly to our knowledge of the control of nitrogen metabolism by experiments on fasted mice. In these animals they showed that the adrenal cortex seemed to control the rate of lymphoid nitrogen depletion and the thyroid the rate of carcass nitrogen depletion. These conclusions were reached on the basis of the following observations: adrenalectomized mice lost no lymphoid nitrogen when starved for 48 hours and cortical steroid administration to these animals increased the loss above that in intact animals. Thyroidectomized mice which had fasted for 48 hours showed no loss of carcass nitrogen and adrenalectomized and thyroidectomized mice did not show a loss of lymphoid or carcass nitrogen on fasting for 48 hours. To show that the secretions of these two glands seemed to regulate the ebb and flow of protein between various body systems the following evidence was offered in adrenalectomized fasted mice there was an actual increase in lymphoid nitrogen in thyroidectomized fasted mice there was a larger decrease in lymphoid nitrogen than in the intact fasted mice. Apparently the secre-



tions of the thyroid gland tend to promote the movement of carcass nitrogen to the lymphoid structures. Furthermore, these workers offered evidence which tended to support the opinion of Wells and Kendall (103) that the adrenal cortex and the thyroid act synergistically in the control of protein metabolism. Noting that the adrenalectomized, fasted, steroid-treated mice lost more carcass nitrogen than did the adrenalectomized fasted mice they suggested that the adrenocortical hormones might augment the thyroid in its control of carcass nitrogen. It might also be noted at this point that the difference of the means of these two groups of animals was equal to between 2 and 3 times the standard error of the difference and so is of questionable significance. In addition, when it is noted that the adrenalectomized, fasted animals did not lose as much carcass nitrogen as the intact, fasted animals (difference of means slightly less than 3 times standard error of differences) these observations become more important.

The significance of these observations is at once evident, the only question being that of the application of findings in a fasting mouse to the phenomenon of increased nitrogen excretion following trauma in the rat and human being. Perhaps the necessity of the presence of the adrenocortical hormones for the protein metabolic response to fracture (58) limb clamping (97) and for the diabetogenic activity of stilbestrol (53) is based on the potentiation of the thyroid gland in its control of carcass nitrogen. In any case these concepts await their application to the deranged protein metabolism following damage.

Basal metabolic rates have been measured by Cuthbertson (32) in patients after fractures which produced increases in urinary nitrogen excretion. These studies do not clarify the situation, however as examination of the author's data reveals no marked change in oxygen consumption when the nitrogen excretion returns to normal, nor any high rates of oxygen usage in cases uncomplicated by fever. The possibility exists that the actions of thyroxine on protein metabolism and on oxygen consumption are dissociated. It is of interest to note that Dunlop found dinitrophenol to increase the basal metabolic rate but not the nitrogen excretion in the urine.

*Other possible influences* It is also interesting to speculate on the role played by other possible influences on the protein metabolic response to trauma. Of particular importance is the effect of shock per se on protein metabolism. Wilhelm (107) has recently outlined the subject most thoroughly. Kline (59,60) demonstrated that a sustained increase in the output of amino acids from

the muscles and an increase in the uptake of amino acids by the liver occurred in the dog after non-fatal hemorrhage. Furthermore, Engel and Engel (34) found that there was a high rate of urea accumulation in the blood for 3 hours following paracental aminoacid infusion in the nephrectomized rat which had been subjected to a nonfatal hemorrhage. In nephrectomized controls the urea blood levels were high only for the first hour. The fact that the livers of these animals were able to form urea from the excessive amino acid nitrogen offered is supported by the evidence of Russell *et al.* and Wilhelm *et al.* (108). They found the rates of oxygen uptake, deamination, and urea synthesis by liver slices, and the concentrations of ammonia, amide, and amino nitrogen in liver tissue were nearly normal in the rat after nonfatal hemorrhage.

These same workers, however, have shown that the liver shows some impairment of deamination and urea synthesis in the more severe hemorrhages. Furthermore, Engel *et al.* (33) have shown that hepatic anoxia due to arrest of the circulation *in vivo* leads to progressive failure of the liver to remove amino acids from the blood. If the period of anoxia was longer than 40 minutes, the 3 hour recovery period, during which the circulation was re-established, led to only partial return of normal function. The explanation of these phenomena may be based partly on the observations of Greg and Alexander who found destruction of co-carboxylase, coenzyme, and aflumarine adenine deacetylase and inactivation of the protein moieties of amino acid oxidase and lactic dehydrogenase following severe hemorrhage.

Harkins and Long found a marked increase in plasma amino nitrogen following a severe burn in the rat. There was a concomitant increase in the whole blood ammonia nitrogen without change in liver ammonia nitrogen, or liver amide nitrogen, and without impairment of the oxygen uptake of liver slices. The question is still open, therefore, as to the part played by these mechanisms in human burns, with or without shock. In any case, hepatic anoxia might possibly explain the high undetermined nitrogen excretion levels in the burn patients of Taylor *et al.* (93). Perhaps the undetermined nitrogen represented some cellular protein breakdown product which was excreted in the urine because it was unable to be deaminated and converted to urea by the damaged liver.

The role of various proteolytic enzymes in human burns is also open to question. Beloff and Peters have demonstrated a decrease in a skin proteinase following burns. Zamecnik *et al.* have found an increase in peptidase activity of serum and lymph coming from a burned area in the dog.

Leach *et al* have called attention to the zone of damaged cells surrounding the severely burned area as a possible site of origin of toxins which in view of the preceding work, might be interpreted to include proteolytic enzymes. Any further statement as to the application of these findings is, of course, hazardous. However it might be pertinent to the discussion to mention that the presence of a proteolytic enzyme liberated from the burned area, and the effects of burn shock on liver metabolism might be added to the effects of the endocrine imbalance and explain the difference noted between the response to burns and to other damaging stimuli.

*The reaction of debility* The clinical observations of Browne *et al* (12) that the debilitated patient fails to show an increase in urinary nitrogen following fracture and also does not exhibit the increase in urinary cortinlike substances is of interest but is unexplained by any of the foregoing considerations. Neufeld *et al* studied blood non-protein nitrogen following nonspecific trauma as applied in a revolving drum. Rats previously exposed to this trauma, and which appeared to be resistant to its effects in terms of mortality failed to show the rise found in the untreated animals. This finding is in accord with those of Selye (92) as to the nonspecific resistance of animals exhibited in the "stage of resistance" of his adaptation syndrome. It might perhaps be thought that the failure of debilitated patients to show the catabolic reaction might be explained on the basis of this acquired resistance to long-continued non-specific trauma.

Of interest to this discussion also are the effects of various diets on the experimental animal's response to trauma. Munro and Cuthbertson observed that after feeding a protein-free diet to rats until steady nitrogen excretion levels were reached fracture was not attended by the usual rise in urinary nitrogen. This finding was interpreted by them to mean that the excessive output of nitrogen which follows injury arises from storage protein and not from essential tissue substance. Cohen and Browne repeated these observations but found that, although fracture was unattended by a rise in nitrogen excretion lowering of the caloric intake was followed by a prompt increase. They therefore concluded that failure to respond to the fracture was not due to exhaustion of the supply of readily available protein. These workers then administered 1 c.c. of adrenocortical extract five times a day to these animals on the low protein diet and again no rise in urinary nitrogen occurred. This last finding is, of course, of extreme importance in view of the work of Ingles

(58) and Tohy and Noble, who found that the giving of constant amounts of adrenocortical extract to adrenalectomized animals allowed a rise in urinary nitrogen following fracture. One might infer from these experiments that the effect of the alteration of the diet was not on the adrenal *per se* but rather on the substrate of the adrenal hormones, or the other factor or factors influencing the protein metabolic response to damage, or both. The work of Mulinos *et al* (77, 78) is also of importance. These workers found adrenal weight loss and decreased adrenal vitamin C concentrations in rats chronically underfed. As this adrenal weight loss was larger on a percentage basis than the loss in body weight, and because the histologic picture of the adrenal cortex was similar to that following hypophysectomy they postulated that chronic underfeeding produced a pseudohypophysectomy. It is not unreasonable to think that the pseudohypophysectomy if produced, might alter the functions of other endocrine glands, namely the thyroid. This mechanism could conceivably be the basis for the peculiar reaction to trauma of the debilitated individual.

#### COMMENT

Further investigations dealing with the differentiation of the response following fracture from that following burns would be profitable. Electrolyte balance studies after burns in the experimental animal in an attempt to confirm Cope's clinical observations and total urinary nitrogen studies following burns in the adrenalectomized animal would be of interest. The elucidation of the relative parts played by the thyroid and adrenal glands in response to trauma would be of great aid. The suggestion by White and Dougherty that the thyroid might serve to funnel protein from the general body tissues to the lymphoid structures which are then broken down and yield an increased nitrogen excretion in the urine is of fundamental importance. As it is well known that lymphoid tissue is high in uric acid the following points are quite pertinent. Babad using adrenocortical extract in rats, and Forsham *et al* (36) using 11-dehydrocorticosterone acetate in patients found that the excretion of uric acid was more consistently raised in the urine than was the total nitrogen. Forsham *et al* (37) found this to be true also following adrenocorticotrophic hormone administration. In spite of the fact that the rare uric acid excretion studies after trauma (24, 95, 100) do not show this fraction of the total nitrogen to be particularly increased relative to the others, this concept is indeed an attractive one and bears further scrutiny.

tions of the thyroid gland tend to promote the movement of carcass nitrogen to the lymphoid structures. Furthermore these workers offered evidence which tended to support the opinion of Wells and Kendall (103) that the adrenal cortex and the thyroid act synergistically in the control of protein metabolism. Noting that the adrenal ectomized, fasted, steroid-treated mice lost more carcass nitrogen than did the adrenalectomized, fasted mice they suggested that the adrenocortical hormones might augment the thyroid in its control of carcass nitrogen. It might also be noted at this point that the difference of the means of these two groups of animals was equal to between 2 and 3 times the standard error of the difference and so is of questionable significance. In addition when it is noted that the adrenalectomized, fasted animals did not lose as much carcass nitrogen as the intact, fasted animals (difference of means slightly less than 3 times standard error of difference) these observations become more important.

The significance of these observations is at once evident, the only question being that of the application of findings in a fasting mouse to the phenomenon of increased nitrogen excretion following trauma in the rat and human being. Perhaps the necessity of the presence of the adrenocortical hormones for the protein metabolic response to fracture (58) limb clamping (97) and for the diabetogenic activity of subcutaneous (53) is based on the potentiation of the thyroid gland in its control of carcass nitrogen. In any case, these concepts await their application to the deranged protein metabolism following damage.

Basal metabolic rates have been measured by Cuthbertson (22) in patients after fractures which produced increases in urinary nitrogen excretion. These studies do not clarify the situation, however as examination of the author's data reveals no marked change in oxygen consumption when the nitrogen excretion returns to normal, nor any high rates of oxygen usage in cases uncomplicated by fever. The possibility exists that the actions of thyroxine on protein metabolism and on oxygen consumption are dissociated. It is of interest to note that Dunlop found dimethylphenol to increase the basal metabolic rate but not the nitrogen excretion in the urine.

**Other possible influences** It is also interesting to speculate on the role played by other possible influences on the protein metabolic response to trauma. Of particular importance is the effect of shock per se on protein metabolism. Wilhelm (107) has recently outlined the subject most thoroughly. Kluge (59,60) demonstrated that a sustained increase in the output of amino acids from

the muscles and an increase in the uptake of amino acids by the liver occurred in the dog after non-fatal hemorrhage. Furthermore Engel and Engel (32) found that there was a high rate of urea accumulation in the blood for 3 hours following parenteral amino acid infusion in the nephrectomized rat which had been subjected to a nonfatal hemorrhage. In nephrectomized controls the urea blood levels were high only for the first hour. The fact that the livers of these animals were able to form urea from the excessive amino acid nitrogen offered is supported by the evidence of Russel *et al.* and Wilhelm *et al.* (108). They found the rates of oxygen uptake, deamination, and urea synthesis by liver slices, and the concentrations of ammonia, amide, and amino nitrogen in liver tissue were nearly normal in the rat after nonfatal hemorrhage.

These same workers, however have shown that the liver shows some impairment of deamination and urea synthesis in the more severe hemorrhages. Furthermore, Engel *et al.* (33) have shown that hepatic anoxia due to arrest of the circulation *in vivo* leads to progressive failure of the liver to remove amino acids from the blood. If the period of anoxia was longer than 40 minutes, the 2 hour recovery period, during which the circulation was re-established, led to only partial return of normal function. The explanation of these phenomena may be based partly on the observations of Greig and Alexander who found destruction of co-carboxylase, coenzyme, and allantoine adenine deacetylase and inactivation of the protein moieties of amino acid oxidase and lactic dehydrogenase following severe hemorrhage.

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The significance of the changes in 17-ketosteroid output in the urine after trauma is far from clear. Mason *et al* and Forsham and Thorn *et al* (37) have recently reported increased excretion of both 17-ketosteroids and 11-oxyteroids in the urine following the administration of purified anterior pituitary corticotrophic hormone to man. Whereas, following trauma when the corticotropin secretion of the anterior pituitary hormone is thought to be increased, the 17-ketosteroid output falls as the 11-oxyteroid output rises.

These are just a few of the defects in our complete understanding of this subject. Perhaps with their elucidation this complex group of events which *in toto* make up the protein metabolic response to trauma will be better correlated. Then too, with the recent advent of the laboratory use of isotopes, perhaps new and important information regarding the internal machinery of the body following damage will become available. This information would be a preferable basis for assumptions concerning this phenomenon than are balance studies.

#### SUMMARY

Following fractures, burns, operations, and other types of trauma there occurs an increased excretion of urinary nonprotein nitrogen. In the majority of the clinical studies after burns, the increase is found in the undetermined nitrogen fraction, whereas after experimental fractures, the urea-ammonia fraction accounts for most of the increase. Associated with this phenomenon is an increased urinary excretion of adrenal corticosteroid substances and a decreased excretion of the 17 ketosteroids.

The assumption that the source of this nitrogen is general body tissue is supported by the observations that the weight lost by a fractured limb of a rat does not account for the excessive nitrogen excreted in the urine, and that following fractures there occurs an increased excretion of the intracellular electrolytes.

The various explanations of these phenomena are centered around a hypophyseal-adrenocortical thyroid mechanism. It is suggested by studies in adrenalectomized rats that the adrenal glands are necessary for the response following fracture but that this response can go on without an increased secretion from these glands. Determinations of carcass and lymphoid nitrogen of fasting mice suggest that the secretions of the thyroid are important in conjunction with those of the adrenal cortex in controlling nitrogen depletion. Whether this mechanism operates following trauma in human beings is at present unproved.

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## CHART II — ANALYSIS OF FAILURES

Type of original graft	Reason for failure	Type of secondary graft	Time for clinical union	Comments
Rb	Resorption and decalcification of graft	Osteoperiosteal	—	Residual bony defect too extensive for osteoperiosteal graft. Ilac graft finally used successfully to produce union
Rb	Resorption and decalcification of distal end of graft	Tibial block and osteoperiosteal	weeks	None
Rib	Resorption and decalcification of graft	Osteoperiosteal	—	Residual bony defect too extensive for osteoperiosteal graft. Ilac graft finally used successfully to produce union
Rb	Resorption and decalcification of graft	Osteoperiosteal	—	Residual bony defect too extensive for osteoperiosteal graft. Ilac graft finally used successfully to produce union
Ilac	Inadequate immobilization of proximal fragment	Osteoperiosteal	weeks	None
Ilac	Infection	Ilac	—	Failure of union at distal end of second graft, probably due to loosening of calcification. Ilac graft was placed under skin and subcutaneous tissue obtained from neck. Chaucer tube pedicle Osteoperiosteal. Second graft finally produced good union
Ilac	Inadequate immobilization of proximal fragment	Osteoperiosteal	weeks	Original Ilac graft extended from right to left across
Ilac	Failure of union at distal end of graft, cause unknown	Osteoperiosteal	7 weeks	None
Ilac	Infection probably due to Kirschner wire used to stabilize symphysis	Osteoperiosteal	weeks	Both the original graft and the osteoperiosteal "freder" were bilateral to replace major loss of the body
Tibial block	Unknown	Ilac	—	Bilateral graft
Osteoperiosteal	Infection	None	—	Patient transferred to another plastic center before secondary graft could be done

Defects of facial contour were corrected by the use of dermal fascial fat grafts obtained from the abdomen or by cartilage implants.

The authors conclude that the important factors affecting bony union are (1) complete absence of residual infection (2) adequate splinting (3) adequate preoperative and postoperative care and (4) a meticulous surgical technique.

FREDERICK W. MERRIFIELD, M.D., D.D.S.

### EYE

#### Ectropion Corrected by Bridge Pedicle Graft H. B. STALLARD, *Brit J Plast Surg* 1948 1:77

The author presents the report of a case of severe ectropion of both lower lids with the everted palpebral conjunctiva hypertrophied and infiltrated with plasma cells in the subconjunctival connective tissue. The eversion and inflammation of the lower lids had been present for 8 years. Excision of a wedge-shaped piece of the tarsal plate and overlying palpebral conjunctiva had been performed on the ectropion of the right lower lid 3 years previously with complete cure employed by the author in this case is described.

1 The everted conjunctiva was excised after incision at the junction of healthy and diseased conjunctiva along a line above and parallel to the lower for nix carried around the medial and lateral canthi and along the posterior line of the lid margin. The excision was carried down to the tarsal plate and subconjunctival tissue was removed with the conjunctiva.

2 The remaining palpebral conjunctiva was entirely undermined.

3 An incision was made in the lower lid parallel to its margin, at a distance of 4 mm. extending from a point medial to the inner canthus to one beyond the outer canthus. The points being at the medial and lateral bases of the upper lid bridge pedicle. The incision was undermined 2 mm upwards and 3 mm down to the lid margin with horizontal mattress sutures of No. 6 black silk, knots being placed on the skin surface.

4 A paramedian tarsorrhaphy was performed with No. 1 white silk vertical mattress sutures passed through squares of oil silk.

5 A bridge pedicle from the upper eyelid, wide enough to fill the raw area in the lower lid was swung forward and then downward and sutured in place. The bridge pedicle supplied extra skin for the shortened lower lid and a sling for holding it in its correct position.

6 The incision in the upper lid was undermined and sutured. The tarsorrhaphy was left for 3 months and then divided.

A photograph which was taken 9 months after operation on both lower lids shows a satisfactory functional and cosmetic result.

EUGENE L. DERLACKI, M.D.

# ABSTRACTS OF CURRENT LITERATURE

## SURGERY OF THE HEAD AND NECK

### HEAD

Mandibular Bone Grafts. IV B. MACOMBER, R.A. SHEPARD and V. E. CROOK. *Plast Reconstr Surg* 948, 3: 370.

The authors present the results of their experience with mandibular bone grafts in a plastic center to which men with facial injuries were assigned. A large number of battle casualties with injuries to the mandible were admitted. Several types of bone grafts were used, and the successes and failures in some 93 cases are recorded.

Tribute is paid to the maxillofacial teams which operated in evacuation, field, and general hospitals in overseas theaters.

The concepts of minimal débridement, adequate early repair of facial wounds, and adequate immobilization and maintenance of normal occlusal relationships were invaluable in the long range care of these patients.

An average period of 2 months had elapsed between the time of injury and admission of the patient to the center and in practically all cases localized bone and soft tissue infection was present, with extraoral or intraoral drainage, or both.

Early definitive care consisted of (1) adequate oral hygiene, (2) control of infection with penicillin and sulfadiazine, (3) incision for drainage and conservative sequestrectomies, (4) conservative but adequate treatment of fractured and infected teeth, (5) adequate splinting and immobilization of the jaw, (6) trismus therapy and (7) high caloric and vitamin therapy.

Late definitive treatment consisted of (1) replacement of lost soft tissue, and (2) restoration of continuity of the mandible. An average period of 9½ months elapsed between admission of the patient and bone grafting, and a minimum of 3 months freedom from infection and drainage was insisted upon before proceeding with the operation. In soft tissue replacements, 2 months were allowed for stabilization of local circulation.

CHART I.—TYPES OF GRAFTS USED

Type of graft	Number used	Interval between injury and graft	Average time for clinical union	Failure of union
Osteoperiosteal	36	months 5-7	weeks 10	
Iliac crest			12	2
Rib	5		12 ½	
Thiatal block		10		
Total	41			

Evaluation of tibial rib and iliac grafts. Osteoperiosteal grafts were obtained from the tibia, and used for minimal defects of 0.5 cm. or less. They were used as primary grafts and also as "feeder" grafts in cases in which there had been failure of union or resorption of a previously placed rib or iliac graft. Infection caused failure of one primary graft, and the "feeder" graft failed to produce union in 3 cases.

Combination grafts of a block of cortical bone from the tibia, overlaid with an osteoperiosteal graft, were used in defects of moderate size not involving the symphysis or the angle. Nine such grafts were used, with but one failure.

Rib or iliac crest grafts were used for all large bony defects of the mandible, the choice of graft being a relatively personal preference. Of 25 rib grafts, 4 failed to produce union because of resorption of a part of the graft with replacement by fibrous tissue.

Grafts from the ilium provide a good source of cancellous bone for replacement of mandibular defects. In 22 cases, only 5 failed to provide union.

*Operative technique.* Nasotracheal anesthesia was used routinely. Adequate exposure of operative sites, designed to fully expose the defect and the proximal and distal fragments, was considered essential.

Superficial scar tissue was mobilized, scar tissue over the bone fragments or in the defect was completely excised. Special attention was given to the preparation of the proximal and distal ends of the bone. The development of active bleeding of bone ends over as large a surface as possible is emphasized. The bone ends were beveled, or mortised joints were used. Tantalum wire was used for fixation. The control of bleeding by the ligation of vessels was considered essential, and prevented the occurrence of postoperative hematomas. Care was taken to avoid oral communication and wound closure was accomplished by the use of subcutaneous and cutaneous sutures of 5.0 and 3.0 catgut. Occasionally 24 hour superficial drains were used and pressure dressings were applied routinely.

Postoperative care is emphasized. The authors believe that constant observation is necessary for 24 to 48 hours, and aspiration to clear mucous secretions. Nurses trained in the postoperative care of these patients are a boon.

Penicillin and sulfadiazine are administered routinely for one week and a high caloric diet is started as soon as it can be tolerated. The first dressing is done on the fourth or fifth postoperative day.

Following satisfactory completion of the bone graft, the development of sulci in the oral vestibule may be necessary to facilitate the construction of dentures. This procedure was accomplished by means of Z-plastics or skin grafts over stent molds.

CHART II—ANALYSIS OF FAILURES

Type of wound	Reason for failure	Type of secondary graft	Time for clinical cure	Comments
LB	Resorption and decalcification of graft	Osteoperiosteal	—	Residual bony defect too extensive for osteoperiosteal graft. Iliac graft finally used successfully to produce union.
RB	Resorption and decalcification of distal end of graft	Tibial block and osteoperiosteal	weeks	None
LB	Resorption and decalcification of graft	Osteoperiosteal	—	Residual bony defect too extensive for osteoperiosteal graft. Iliac graft finally used successfully to produce union.
RB	Resorption and decalcification of graft	Osteoperiosteal	—	Residual bony defect too extensive for osteoperiosteal graft. Iliac graft finally used successfully to produce union.
Iliac	Inadequate immobilization of proximal fragment	Osteoperiosteal	weeks	None
Iliac	Infection	Iliac	—	Failure of union. I distal end of second graft, probably due to inadequate immobilization, since graft was placed under skin and subcutaneous tissue obtained from neck. Best ruled pedicle osteoperiosteal. Iliac graft finally produced good union.
Iliac	Inadequate immobilization of proximal fragment	Osteoperiosteal	weeks	Original Iliac graft extended from right to left radius.
Iliac	Failure of union at distal end of graft, cause unknown	Osteoperiosteal	7 weeks	None
Iliac	Infection; probably due to skin over wire used to stabilize symphysis	Osteoperiosteal	weeks	Both the original graft and the osteoperiosteal "inorder" were bilateral to replace a major loss of the body.
Tibial block	Unknown	Iliac	weeks	Bilateral graft.
Osteoperiosteal	Infection	None	—	Patient transferred to another plastic center before secondary graft could be done.

Defects of facial contour were corrected by the use of dermal fascial-fat grafts obtained from the abdomen or by cartilage implants.

The authors conclude that the important factors effecting bony union are: (1) complete absence of residual infection; (2) adequate splinting; (3) adequate preoperative and postoperative care; and (4) a meticulous surgical technique.

FREDERICK W. MEERBOLD, M.D., D.D.S.

## EYE

### Ectropion Corrected by Bridge-Pedicle Graft H. B. STANLEY, *Brit J Plst Surg* 1948, 1

The author presents the report of a case of severe ectropion of both lower lids with the everted palpebral conjunctiva hypertrophied and infiltrated with plasma cells in the subconjunctival connective tissue. The eversion and inflammation of the lower lids had been present for 5 years. Excision of a wedge-shaped piece of the tarsal plate and overlying palpebral conjunctiva had been performed on the correction of the right lower lid 3 years previously, with complete failure to correct the deformity. The operative procedure employed by the author in this case is described.

1. The everted conjunctiva was excised after incision at the junction of healthy and diseased conjunctiva along a line above and parallel to the lower fornix carried around the medial and lateral canthi and along the posterior line of the lid margin. The excision was carried down to the tarsal plate and subconjunctival tissue was removed with the conjunctiva.

2. The remaining palpebral conjunctiva was entirely undermined.

3. An incision was made in the lower lid parallel to its margin at a distance of 4 mm, extending from a point medial to the inner canthus to one beyond the outer canthus, the points being at the medial and lateral bases of the upper lid bridge pedicle. The incision was undermined 2 mm upwards and 3 mm downwards. The healthy conjunctival margin was sutured to the lid margin with horizontal mattress sutures of No. 6 black silk, knots being placed on the skin surface.

4. A paramedian tarsorrhaphy was performed with No. 1 white silk vertical mattress sutures passed through squares of oil silk.

5. A bridge pedicle from the upper eyelid, wide enough to fill the raw area in the lower lid, was swung forward and then downward and sutured in place. The bridge pedicle supplied extra skin for the shortened lower lid and a sling, for holding it in its correct position.

6. The incision in the upper lid was undermined and sutured. The tarsorrhaphy was left for 3 months and then divided.

A photograph which was taken 9 months after operation on both lower lids shows a satisfactory functional and cosmetic result.

JOHN J. DYBALKI, M.D.



Atrophie Gyrate Choroides et Retinae. JOKAN SAEBO. *Brit J Ophth* 1913, 33, 824.

In analysis of the 30 previously reported cases of choroideremia and gyrate atrophy reveals no essential difference between them, and Saebo concludes they are the same entity. He presents a thorough study of 4 additional cases in brothers ranging in age from 37 to 46 years who came from a family of 9 children. Evidence of consanguinity was absent, nor was the condition present in a descendant nor in three generations of ascendants. The mother aged 70, had normal eyes except for white atrophic halos around the optic discs.

The fundus picture in the 4 brothers was strikingly uniform and symmetrical in both eyes, the only variation being due to the progress of the disease. The optic discs and retinal vessels were unaffected. The macular region was represented by a reddish island which was surrounded by glistering white atrophy. Within this island were scattered pigment dots, most densely set within the macula proper. With age this area became reduced until merely a grayish-brown patch remained the zone of atrophy widened and the choroidal vessels going from macula to periphery decreased both in number and caliber. The pigment disappeared from the trophic zone being deposited along the borders. In all these cases, there was a fairly normal chorioretinal rim, the crystalline lenses were clear and a typical annular scotoma was seen.

The symptoms are first light blindness, present from early youth. Inconvenience later from the reduced field of vision and eventually a lessening of central acuity which may be reduced to light perception at the age 40. The color sense remains normal. Myopia has been found in three-quarters of all cases reported.

This familial condition indicates a recessive mode of heredity.

JAMES E. LEBENSOHN, M.D.

The Prognosis of Sarcoma of the Choroid. J. B. VOS. *N. Y. Med J* 1913, 117, 34, Supp.

Hamilton reports 1 case of choroidal sarcoma from his personal practice in Southern Tasmania which has been watched for years or more. He agrees with Martin Jones that malignant cells in the venous outlets from the globe do not necessarily denote a bad prognosis. Of his 7 patients with extensions into the sclera 4 are still alive.

He hazards the opinion that in early extension the growth may be less encapsulated than somewhat later. Since von Hippel found that excision in the pre-glaucomatous stage resulted in a mortality of 33 per cent while excision in the glaucomatous stage produced a mortality of 10 per cent.

JAMES E. LEBENSOHN, M.D.

#### EAR

Otosclerosis in Childhood. WILLIAM MCKENZIE. *J. Lar. Otol. Lond* 1913, 6, 66.

The author reports the results of fenestration performed in 3 cases of otosclerosis in which the history

of hearing impairment began in childhood. In his preliminary discussion he states that at the Deafness Clinic of the Middlesex Hospital, 8 patients of a total of 300 suffering from otosclerosis gave a history of deafness before the age of 15 years.

In the experience of the author the diagnosis of deafness in children is difficult because the child does not complain of deafness, he cannot remember hearing well and so has no standard for comparison. The parents usually complain of disobedience and inattention in the child rather than deafness. However he believes that the history depends on the accuracy of the parents' observation.

Cardinal points of diagnosis of otosclerosis in childhood are a family history and a noticeable deafness for some years becoming deeper without earache or otorrhea, in contrast to a history of repeated deafness with colds and the absence of a profound deafness in the presence of infected otoids. The majority of cases of perceptive deafness can be ruled out by the presence of normal speech and by the fact that perceptive deafness in children does not increase steadily.

In the realm of objective testing, the tests with tuning forks yielding a negative Rinne for 256 and 512 cycles with a profound loss of hearing, suggest otosclerosis. Another test used is the valve amplifier and if a deaf child speaks normally and can understand speech with a valve amplifier the diagnosis is conductive deafness. According to the author the air conduction audiogram shows a characteristic curve corresponding to that which may be expected in young people with otosclerosis.

The author believes, however, that the diagnosis of otosclerosis is so difficult in a child that the distinction from middle ear deafness due to adenoids may be impossible. In all his cases the postnasal space was examined and adenoids were removed in the course of investigation.

As to making the difficult decision about fenestration the author states that it must be made by the parents and the otologist and the author's advice in each case was for operation.

Case 1 was that of a child 1 year of age who had a 2 year history of deafness which was not improved by tonsillectomy and adenoidectomy and subsequent inflation of the eustachian tubes. In the speech frequencies the hearing in the right ear was 35 decibels and in the left ear 33 decibels. At fenestration on the left ear the stapes was found to be fixed. Three months after operation the speech level in the left ear was 20 decibels a gain of 13 decibels.

Case 2 was also one of a girl 11 years of age with the complaint of deafness since the age of 7 years and a history of otorrhea in both ears 6 months before examination lasting 3 weeks. There had been no improvement following tonsillectomy and adenoidectomy elsewhere 6 months previously. The hearing levels in the speech frequencies were 4 decibels in the right ear and 48 decibels in the left ear. The stapes was fixed at fenestration on the left ear. The postoperative audiogram at 1 month

showed a speech level of 33 decibels a gain of 15 decibels

Case 3 was a patient 22 years of age who was first seen because of deafness of 1 year's duration at the age of 12 years. Removal of adenoid remnants followed by eustachian tube inflation had produced no improvement. The preoperative audiogram showed a speech level of 27 decibels in the left ear and 40 decibels in the right ear. A fenestration operation was performed on the right ear and the stapes was found to be fixed. The postoperative audiogram at 8 months showed a speech level of 23 decibels a gain of 17 decibels.

In conclusion the author states that fenestration has improved the hearing in each case although it is too early to say whether this improvement is permanent.

EUGENE L. DERLACKI M D

### NOSE AND SINUSES

**Columella Reconstruction** MORTIMER H SHAW and STEPHEN R. FELL, *Brit J Plast Surg* 1948, 1 111

The authors present a report of the plastic reconstruction effected in a case of nasal deformity resulting from syphilis. The deformity was an extensive course of specific treatment in 1940. The following destructive changes had occurred in the nose: (1) the columella was represented by a thin bridge of scar tissue (2) the tip of the nose to the right of the midline was drawn backwards into a deep cleft and was adherent to the remains of the nasal septum (3) the cartilaginous septum had been almost entirely destroyed with a resultant large perforation (4) the lining of the vestibule of the nose and alae was scarred and the mucous lining of the nose was destroyed and replaced by scar tissue.

The reconstructive surgery was carried out in stages as follows:

**Stage 1** Through an oronasal opening made in the upper buccal sulcus the whole skin covering of the nose was freed from the septal remains and from the pyriform opening. The resulting raw surface was grafted by a thin dermatome graft from the arm on a stent mold which overdistended the cavity. This was replaced by an acrylic mold at the tenth day dressing.

**Stage 2** Twenty three days later under brachial plexus block a tubed pedicle 4.5 cm. by 3 cm. was raised on the dorsal aspect of the left hand over the finger and the defect in the hand was filled by a Thiersch graft.

**Stage 3** Thirty five days later under local anesthesia the columellar remnant was excised and the proximal end of the tubed pedicle from the hand was implanted under the nasal tip. The hand was maintained in position by "handle bar" attachment between a plaster of paris headcap and a plaster cuff on the left wrist. The nose was supported by an acrylic "plumper" on two curved bars attached to an upper dental cap splint with a central locking plate.

**Stage 4** Seventeen days later the columellar implant was detached from the hand under local anesthesia. The rest of the procedure was done under general anesthesia. The columellar graft was implanted in the upper lip over the anterior nasal spine. The oronasal opening was closed after excision of the excessive portion of skin graft by suturing the buccal mucosa. The nose was supported by the extraoral appliance with the two acrylic plumpers.

**Stage 5** Three months later under general anesthesia a bone graft from the iliac crest was inserted through a tip incision between the covering skin and the lining graft of the nasal cavity extending to the glabella after denuding the nasal bridge of periosteum. A plaster slab splint was applied and the supporting appliance discarded.

An illustration shows the present appearance of the patient with the final scar excision between tip and columella yet to be performed.

EUGENE L. DERLACKI M D

**Osteoma of the Frontal and Ethmoid Sinuses.** H. BRUNNER and I. G. SPIESMAN *Ann Otol Rhinol* 1948 57 714

The authors present 4 very complete case reports of frontal or ethmoid sinus osteomas. The findings in these cases prove that in the paranasal sinuses (1) osseous tumors occur which bulge into the sinuses and are covered by the sinus mucosa (2) in elderly individuals particularly they may remain small and may cause no symptoms and should therefore be called "osteomas" (3) in younger individuals however they may become very large and form typical osteomas with more severe symptoms depending upon whether the tumor invades the orbit and causes diplopia, or whether it extends upward and backward to invade the brain.

The authors believe that evidence of extension of these lesions should be waited for but that an osteoma which appears to be growing should be removed surgically at once because osteomas of the paranasal sinuses may destroy surrounding tissue not only by an increase in the size of the tumor but also by the formation of mucocoeles from obstruction of the nasofrontal duct. There appear to be no definite signs or symptoms which would indicate when the osteoma has extended to the dura.

The 4 cases presented include (1) an elderly individual with localized osteoma of the frontal sinus which was asymptomatic and did not increase in size during a 5 year period (2) a 17 year old white male with an osteoma of the frontal sinus which had extended down into the orbit and was successfully excised surgically (3) a 34 year old white male with an osteoma of the left ethmoid and the sphenoid sinuses, which extended upward and backward, breaking through the dura of the anterior fossa and causing a malacia of the base of the frontal lobe and death from meningitis (by exposing the brain to infection from the nasal cavity) (4) a 49 year old white male with an osteoma of the frontal sinus ex-

tending posteriorly to erode the dura of the frontal lobe, with superficial necrosis of the brain, and a large intracranial and cerebral pneumatocephalus.

WILLIAM K. WRIGHT M.D.

### MOUTH

**Mandibular Fractures in Children.** GEORGE W. M. TIERNEY and THOMAS V. MAGRUDER, JR. *J. Pediatr. S. Louis*, 94:3, 33-495.

The management of mandibular fractures in children presents unusual difficulties not found in similar fractures in adults. This is because the deciduous teeth, the 6 year molars and the permanent incisors make very poor anchors for intermaxillary wiring. There is little to be found in the literature or in authoritative text books concerning the management of mandibular fractures in children. Skeletal fixation is of little value because of the danger of inserting pins into tooth buds. In uncomplicated cases without much displacement, a head cap with an elastic bandage under the chin or a canvas aviator's helmet with the same elastic bandage may be effective. However, in cases in which there is wide separation of segments, necessitating considerable traction and very firm fixation, the authors have found open reduction with direct wiring of the bone with tantalum wire to be the best procedure. With this method of treatment, strict asepsis and postoperative protection with penicillin to avoid infection are important, as well as the observance of special care to prevent the occurrence of any damage to the tooth buds of the permanent teeth.

WILLIAM K. WRIGHT M.D.

### PHARYNX

**Associated Symptomatology of Diseases of the Epipharynx.** WALTER H. TROSBALD. *Ann. Otol. Rhinol.* 94:3 57-677.

Examination of the epipharynx is too often neglected in the routine examination. It is of special importance in cases of postnasal discharge, recurrent sore throats, cough, repeated earaches, recurrent colds, hoarseness, bronchitis, unexplained fever, bloody sputum, crusting, and occipital headaches. The author reports 150 cases observed over a 3 year period in which epipharyngeal pathology was the sole apparent cause of these symptoms, exhaustive study having eliminated all other possible pathological factors. In each case the symptoms were alleviated after therapy to the epipharynx. Therapy consists of surgical removal of hypertrophied lymphoid tissue or pharyngeal bursa, if present, followed by irradiation with the 50 mgm model metal radium applicator (Crowe technique). Local treatment consisted of the application of 5 per cent silver nitrate through the Yankauer speculum and, in cases, electrocauterization when bleeding was the predominant symptom.

Examination of the epipharynx is carried out by anterior and posterior rhinoscopy with the use of the

nasopharyngoscope, and by direct nasopharyngoscopy with the Yankauer speculum. In a few of the cases the pathology consisted of pharyngeal barns, lymphoid hypertrophy and the presence of purulent or jellylike secretions. The author states that one should always be on the alert for the presence of an epipharyngeal carcinoma.

WILLIAM K. WRIGHT M.D.

### NECK

**The Significance of the Protein-Bound Blood Iodine in Patients with Hyperthyroidism.** GEORGE M. CURTIS and ROY E. SWENSON. *Ann. Surg.* 94:3, 5-8-443.

The authors point out that much of the confusion encountered in the making of a diagnosis of so-called borderline hyperthyroidism has arisen because there are but few direct methods of measuring thyroid function itself. The basal metabolic rate is a measure of oxygen consumption which is the end result of many oxidative processes. Thus it may be altered by hyperplastic neoplastic diseases such as carcinoma or leukemia, psychiatric diseases and the menopausal syndrome. This may be an especially difficult problem when nodular goiter also is found to be present.

As a test of the qualifications of the estimation of the protein-bound iodine as a diagnostic procedure, the authors have studied the relationship between the basal metabolic rate and the protein-bound iodine in patients treated with a thyroid stimulating hormone and in patients treated with a thyroid blocking drug as propylthiouracil. A direct linear relationship was observed.

A series of 178 patients with nontoxic nodular goiter was then studied. It was concluded from this study that the iodoprotein level was a better index of thyroid activity than the basal metabolic rate. Hypertension, organic heart disease, neurocirculatory asthenia, psychoneurosis, neoplasms, and adrenocortical syndromes did not result in any elevation of the iodoprotein level.

A significant relationship between the basal metabolic rate and the protein-bound iodine was found in the cases of toxic nodular goiter studied. Furthermore, the protein-bound iodine seemed to suggest the subtle development of hyperthyroidism in the nontoxic nodular group. In cases of primary hyperthyroidism a similar relationship existed between the basal metabolic rate and the protein-bound iodine, but at higher levels. This presumably means that the patients had a higher grade of hyperthyroidism.

After iodine therapy the response of the protein-bound iodine in primary hyperthyroidism differs from that in toxic nodular goiter. In the former the response followed the usual lines, while in the latter the response seemed to follow that noted following the addition of iodine to whole blood *in vitro*. The authors were uncertain as to the significance of this finding.

WILLIAM C. BECK M.D.

Complications Following Irradiation of the Thyroid Gland. R. M. LUKENS. *Ann Otol Rhinol*, 1945 57 633.

Among roentgenologists irradiation of the thyroid gland is the method of treatment indicated for exophthalmic goiter and hyperthyroidism how ever the dose must be controlled, and filtration must be properly applied. Overdosage must be strictly guarded against.

The indiscriminate use of irradiation in the attempt to cure nonmalignant diseases of the thyroid gland can be damaging to the underlying larynx and trachea. The damage done to these structures is permanent and will require a lifetime of treatment in addition the patient is constantly in danger of death due to asphyxia.

In the 5 cases recorded, obstruction to the airway was due not only to pathological narrowing of the larynx and trachea, but to the altered secretion ac cumulating at the point of stenosis.

Cartilages of the larynx and trachea are suscep tible to intensive irradiation. Even slight overdoses will end in disastrous perichondritis necrosis ateno sis, or sloughing.

Clerf reported 2 cases of exophthalmic goiter in patients who had had irradiation previously, and who required emergency tracheotomies on admission to his service. The wounds sloughed because of the devitalized pretracheal tissues.

Changes taking place in the neck and trachea are not at once apparent, and x ray films are of little or no help for generally they are negative. The condi tion may start as a tracheobronchitis which does not clear up but progresses to a definite localised lesion. The degenerative process is slow and may not give alarming symptoms until several years later when the damage is permanent and progres sive.

Epithelium desquamates and the functions of the gland are either changed or destroyed, resulting in altered tracheal secretion which is not moved readily by ciliary action and which adheres to eroded and granulosomatous surfaces. Crusts constantly form and are attached to the damaged areas. Prolifera tion of granulation tissue and in some cases dei dyspnea occurring as a result of the stenosis is markedly increased by the thick secretions and crusts collecting about the stenosed area.

In all 5 of the patients the symptoms developed after an interval of from 1 to 7 years following irra diation of the thyroid gland.

The patients complained of hoarseness sensation of a lump in the throat, inspiratory dyspnea, wheez ing dysphagia expectoration loss of weight and pain in the chest.

The following physical findings were observed congestion of the laryngeal mucosa, telangiectasis and inflammation of the laryngeal mucosa, telan giectasis of the vocal cords stenosis of the trachea, granulosomatous lesions in the tracheal walls crowd ing inward of the tracheal wall, viscid adherent

tracheal secretions, and crusting. Cicatrices are not a common finding only a suggestion of cicatricial tissue was present in one case.

Tracheotomy was required in 3 cases. Treatment consisted of the removal of encrusta tions from the trachea and larynx the cauterization of granulations and dilating stenotic areas. The author's patients required treatment for periods of from 1 to 11 years after development of their symp toms.

EDMUND R. DONOGHUE, M.D.

The Open Approach to Arytenoidectomy for Bilat eral Abductor Paralysis, with a Report of 23 Cases. DE GRAAF WOODMAN. *Ann Otol Rhinol* 1948 57 605

The author presents a report of 14 personal cases and 9 cases observed by fellow otolaryngologists throughout the country.

He describes his modification of the extralaryngeal approach to arytenoidectomy in which a more open approach and a wider field is advocated for the com plete removal of the articular part of the arytenoid cartilage and the fixation of the vocal cord laterally to the thyroid cartilage.

The average estimated size of the postoperative glottic chink was 4.5 mm. Most of the patients had improved voices although some had only adequate voices. There was one death among the author's own cases.

All except 2 of the 23 patients discarded their tracheotomy tubes. These 2 had adequate epiglottic chinks but refused to go without their tubes be cause of an anxiety neurosis.

The results obtained with this operation by several surgeons throughout the United States indicates general success of the technique described.

EDMUND R. DONOGHUE, M.D.

Further Operative Results of Carcinoma of the Larynx. TH. D. DEMETRIADES and D. IOANNOWICH. *J Lar Otol* Lond., 1945 63 613

In an earlier publication the authors reported the results obtained following operations for carcinoma of the larynx during a period of 6 years in the clinic of the Greek Red Cross Hospital 10 Athens. These early results are shown in Table I.

In the present study the authors review their work from 1931 to 1947 inclusive which consists of 88 cases however only 74 operations are considered here as the last 14 patients were operated upon too recently for inclusion in the series. In a large major ity of cases the disease occurred in the fifth sixth and seventh decades of life. Among 88 cases there was but 1 female, which differs from the commonly accepted ratio of 10 males to 1 female. The laryngeal type of carcinoma of the larynx (53 cases) was very frequently found to be limited to the vocal cords and the extrinsic type (in 21 cases) to the epiglottis. Most of the intrinsic carcinomas showed differentiation histologically (epithelial pearls) where as the majority of extrinsic carcinomas were undiffer entiated.

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WILLIAM K. WRIGHT M.D.

### MOUTH

**Mandibular Fractures in Children.** GEORGE W. MATTHEWS and THOMAS V. MAGRUDER, JR. *J. Pediat.* 5 Louis, 1948, 33: 495

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WILLIAM K. WRIGHT M.D.

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WILLIAM K. WRIGHT M.D.

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WILLIAM C. BECK, M.D.

# SURGERY OF THE NERVOUS SYSTEM

## BRAIN AND ITS COVERINGS CRANIAL NERVES

Follow Up Study of Men with Penetrating Injury to the Brain JOHN A. AITA. *Arch. Neurol. Psychiat. Chic.* 1948 59 511

The author has made a follow up study of 100 patients who received penetrating brain injuries during World War II. He studied these patients more than 6 months after their discharge from an Army neurological center and for periods of 1 to 2 years after the injury. These 100 patients were surgically proved to have had dural penetration and injury to the brain by shell fragments or gunshot and were taken from a series of 320 men with cranio-cerebral injuries admitted to an Army neurologic neurosurgical center in the Zone of the Interior during World War II. Most of these men arrived at the center within 6 months after injury and were hospitalized from 3 to 9 months.

At this stage of the follow up 28 men had required further medical attention for symptoms referable to cranio-cerebral injury. Their chief complaints were convulsive seizures, headaches, fainting, emotional instability, anxiety and fatigue. These symptoms were of more concern than paralysis, hemianopsia, aphasia or sensory loss. All patients were receiving disability pensions and those who were receiving less than 100 per cent compensation were dissatisfied. Sixty-two men showed significant improvement. Headaches were more common among those who had them while hospitalized and those with less severe damage to the brain.

At the time of the follow-up study 34 men had had at least one convulsive seizure, the onset of which usually began from 4 to 9 months after the time of injury.

DANIEL RUGE, M D

Sturge-Weber Syndrome. ARCHIBALD D. MCCOY and HAROLD C. VORIS. *Arch. Neurol. Psychiat. Chic.* 1948, 59 504.

The Sturge-Weber syndrome has also been named the Kallischer-Dimitri disease and the Bruchfeld-Wyatt disease for the men who described the same condition in the eighteenth century. In this condition there is a facial nevus associated with hemolateral glaucoma and an angiomatous pathologic process involving the pia mater and the cerebral cortex. The brain shows a decreased quantity of white matter and areas of calcified blood vessels which have an "angeworm" appearance. The occipital lobe is the most commonly affected area.

Symptoms of the illness are convulsions, paralysis, mental retardation and visual disturbances, and since the pathology is usually in the occipital lobe there is a homonymous hemianopsia. Other ocular symptoms and signs which occur are optic nerve atrophy, papilledema, nystagmus, unequal pupils

and congenital glaucoma. The illness progresses slowly and the life expectancy is very good.

Treatment of the disease has varied and depends more upon the surgeons than upon the variations of the disease. Both radium and roentgen irradiation have been used. Surgery has varied considerably. The authors state that Pilcher obtained a good result from an occipital lobectomy for an angioma of the occipital lobe. Others have attempted to attack the vascularity either by ligating the internal carotid artery or ligating the surface vessels of the cortex.

The authors have observed a patient with the Sturge-Weber syndrome for 7 years. He appeared to be normal at birth except for an extensive nevus of the left side of the face, neck, and left upper extremity. However, when he was 7 months of age he had his first convulsive seizure limited to the right side of the body. He did not progress as a normal child; he became weak and inco-ordinated, and a glaucoma of the left eye was noted in early childhood. Examination revealed increased deep tendon reflexes on the right, pathological reflexes on the right, and a right homonymous hemianopsia. Roentgenograms of the skull revealed an angworm area of calcification in the left occipital lobe and in the left posterior fossa. The patient has had little relief from anticonvulsant drugs, and there has been neither regression nor progression of the disease during the 7 years that he has been under observation.

DANIEL RUGE, M D

A Pneumographic Study of the Temporal Horn with Special Reference to Tumors in the Temporal Region. ERIK LINDQREN. *Acta radiol. Stockh.* 1948, Supp. 69.

It is fitting that a monograph of this kind should be written in memory of Professor Erik Lysholm of Stockholm by a former student. Part of the monograph formed the basis of a paper delivered before the Royal Society of Medicine in May 1947. The work described was carried out at the Seraphimer Hospital during the period between 1937 and 1947 through the co-operation of the department of neurological surgery under Professor Olivecrona, the department of neurology under Professor Antoni, and the department of roentgenology under Professor Lysholm.

The material consists of 137 cases studied roentgenologically at operation, and at autopsy. In general, the work consists of an anatomical description of the normal temporal horn and the roentgenological examination of the temporal horn. The work is further amplified to include a general discussion of the pathologic anatomy of expanding intracranial lesions and their effects on the temporal horn. A special and by far the largest section of the monograph portrays the effects of tumors situated in special regions, and the manner in which they cause

TABLE I—CARCINOMA OF LARYNX 1931-1937

Type of Operation	Total No.	Deaths	Recurrences	Cures (5 years)
Laryngofissure (1931-1937)		—	—	—
Laryngofissure & Cricoid Thyroidectomy (1931-1937)			2	—
Maldissection II (1931-1937)		—	—	3
Total laryngofissure (50)		2	2	3
		5%	4%	6%
Total	12	6	2	3
Percentage		50%	16.6%	25%

TABLE II—INTRINSIC CARCINOMA 1931-1937

Type of operation	Total	Deaths	Recurrences	Cures (years)
Laryngofissure (1931-1937)		—	—	—
Laryngofissure partial laryngectomy (1931-1937)				—
Total laryngofissure (1931-1937)				—
Total	5	3	0	—
		60%	0%	0%

Total laryngectomy was performed in 35 cases (1931-1937) and the lymph nodes lying along the carotid vessels were removed only in those cases in which these were either palpable externally or in which the histological picture of the primary growth was that of the undifferentiated type. Excision of the epiglottis was performed in 4 cases. Laryngofissure was performed in 35 cases and was reserved for those patients in whom the growth involved only the middle part of one vocal cord; mobility was unaffected and the growth did not extend below the cricoid glottis. The details and results of these operations are listed in Tables I, II, III and IV.

The results of total laryngectomy from 1931 to 1937 in 35 cases were as follows:

In 6 cases, or 7 per cent, cures were obtained for from 7 to 17 years. In 2 of these the carcinomas were

TABLE III—EXTRINSIC CARCINOMA 1931-1937

Type of operation	Total	Deaths	Recurrences	Cures (5 years)
Maldissection II (1931-1937)	3	—	—	3
Total laryngectomy (1931-1937)	1		7	1
Total	4		7	4
		17%	175%	100%

TABLE IV—OPERATIVE RESULTS OF LARYNGOFISSURE AND PARTIAL LARYNGECTOMIES

Type of Operation	Total	Post-operative deaths	Recurrences	Cures (total)	Cures (5 years)
Laryngofissure and laryngectomy (1931-1937)	27				—
Partial laryngectomy (1931-1937)			2	—	—
Maldissection II (1931-1937)		—	—	3	—
Total	29	4	2	3	1
Percentage (%)		13.8%	6.9%	10.3%	3.4%

\*Death due to spontaneous pneumothorax after 3 years.

extrinsic and in 4 intrinsic with differentiation histologically. Ten patients, or 26 per cent, died following the operation as a result of respiratory complications. Recurrence was observed in 13 cases, or 37 per cent, in from 6 to 8 months after the operation, mostly in cases of extrinsic carcinoma which histologically did not show cell differentiation.

The percentage of 5 year cures following total laryngectomy was only 17 per cent while the combined percentage of cures following laryngofissures and laryngectomies was 43 per cent. Complementary irradiation was administered in all cases except those in which laryngofissure was performed.

During the period when sulfonamides and penicillin were available, no postoperative deaths occurred.

Early diagnosis by biopsy is essential. The authors consider irradiation without surgical treatment as a palliative measure only.

ERNEST D. BLOOMENTHAL, M.D.

# SURGERY OF THE NERVOUS SYSTEM

## BRAIN AND ITS COVERINGS CRANIAL NERVES

Follow Up Study of Men with Penetrating Injury to the Brain JOHN A. ARTA. *Arch. Neurol. Psychiat. Chic.*, 1948, 59 511

The author has made a follow-up study of 100 patients who received penetrating brain injuries during World War II. He studied these patients more than 6 months after their discharge from an Army neurological center and for periods of 1 to 2 years after the injury. These 100 patients were surgically proved to have had dural penetration and injury to the brain by shell fragments or gunshot and were taken from a series of 320 men with cranio-cerebral injuries admitted to an Army neurologic neurosurgical center in the Zone of the Interior during World War II. Most of these men arrived at the center within 6 months after injury and were hospitalized from 3 to 9 months.

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Laryngofissure Rt. Cleft Thompson (technique) (1931-1935)			3	—
Maldisque-Hajak (1931-1937)		—	—	3
Total laryngectomy (1931-1937)		3	3	3
		21 8%	24 66%	24 66%
Total	24	3	3	3
Percentage		12 5%	24 58%	24 67%

TABLE II.—INTRINSIC CARCINOMA 1931-1937

Type of operation	Total	Deaths	Recurrences	Cures (5 years)
Laryngofissure (1931-1937)		—	—	—
Laryngofissure partial laryngectomy Rt. Cleft Thompson (1931-1937)				—
Total laryngectomy (1931-1937)				3
		20%	0%	30%
Total	3			
		20%	0%	30%

Total laryngectomy was performed in 35 cases (1931-1937) and the lymph nodes lying along the carotid vessels were removed only in those cases in which these were either palpable externally or in which the histological picture of the primary growth was that of the undifferentiated type. Excision of the epiglottis was performed in 4 cases. Laryngofissure was performed in 35 cases and was reserved for those patients in whom the growth involved only the middle part of one vocal cord; mobility was unaffected, and the growth did not extend below the rima glottidis. The details and results of these operations are listed in Tables II, III, and IV.

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Type of operation	Total	Deaths	Recurrences	Cures (5 years)
Maldisque-Hajak (1931-1937)	3	—	—	—
Total laryngectomy (1931-1937)	21		7	—
Total	24		7	3
		29%	29%	12%

TABLE IV.—OPERATIVE RESULTS OF LARYNGOFISSURE AND PARTIAL LARYNGECTOMIES

Type of Operation	Total	Post-operative deaths	Recurrences	Cures (5 years)	Cures
Laryngofissure chondro-ectomy (1931-1937) (1931-1937)	27	10		21	7
Partial laryngectomy (1931-1937)			3	—	—
Maldisque-Hajak (1931-1937) 911		—	—	—	100
Total	26	10	3	21	7
Percentage (%)		38	11	81	27

Death due to spontaneous pneumonia after 5 years.

extrinsic and in 4 intrinsic with differentiation histologically. Ten patients, or 26 per cent, died following the operation as a result of respiratory complications. Recurrence was observed in 13 cases, or 37 per cent, in from 6 to 8 months after the operation, mostly in cases of extrinsic carcinoma which histologically did not show cell differentiation.

The percentage of 5 year cures following total laryngectomy was only 17 per cent, while the combined percentage of cures following laryngofissures and laryngectomies was 43 per cent. Complementary irradiation was administered in all cases except those in which laryngofissure was performed.

During the period when sulfonamides and penicillin were available, no postoperative deaths occurred.

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ERNEST D. BLOOMENTHAL, M.D.

cartilage so that its contraction would cause ascent of the larynx. During the postoperative period the patient was taught to so grimace with the lower face that the digastric contracted at the instant of swallowing. By this maneuver the larynx was elevated and the patient was trained to swallow. It has now been more than 2 years since the operation and there has been no occasion to have recourse to the stomach tube. Swallowing is sufficiently satisfactory that the patient has been able to work in construction camps and partake of the more or less rough food which is available.

This work is well illustrated with several drawings and diagrams, illustrating not only the surgical technique but also the various phases and mechanisms of normal and abnormal deglutition.

HOWARD H. LANDER, M.D.

### SPINAL CORD AND ITS COVERINGS

**Surgical Experiences with Extramedullary Tumors of the Spinal Cord.** FRANCIS G. GRANT. *Ann Surg* 945, 8 679.

This communication deals with a group of tumors, namely the intradural, extramedullary and fibroblastic tumors as well as with their diagnosis, localization and surgical removal.

Since 1924 108 tumors of this type have been recorded in the Neurosurgical Service of the University and Postgraduate Hospital of the University of Pennsylvania. Of these 108 tumors 78 were found in females and 30 in males an unexpectedly high incidence of this type of tumor in women. The average age was 45.5 years, the youngest 10, and the oldest 78. Twenty-four of these tumors were in the cervical area of the cord, 70 in the thoracic area, 6 in the lumbar cord and 8 involved the cauda equina. The author states that a laminar puncture with the application of the Queckenstedt test is an essential part of the study of any spinal cord lesion. If a tumor is suspected and if the hydrodynamic reactions and

chemical studies of the spinal fluid are not entirely normal, oil should always be introduced into the sub-arachnoid space of the spinal canal. It appears that oil is the most active means of reaching a level diagnosis.

In the group of cervical cord tumors, 6 lesions were situated at the level of the foramen magnum. In 3 instances the tumors were so nearly intracranial that cerebrospinal fluid circulation was impaired and a choking of the discs was reported. Three fatalities occurred in this group.

The question of operating upon the completely paralyzed patient is pointed out by the author. Sixteen patients (7 in whom the tumor was located in the cervical area and 9 in whom the tumor was located in the thoracic area) had total spastic paraplegia of the legs, loss of sphincter control and a complete or almost complete sensory loss below the level of the tumor. In the cervical group of tumors (7) the period from the onset of symptoms to the operation averaged 22 months and the period of complete paralysis averaged 10 weeks. In the thoracic group of tumors (9) the average time of duration of the symptoms was 26 months, and of complete paralysis 6 weeks. Yet all these patients made complete recoveries: those with cervical lesions in an average time of 18 months after tumor removal and those with thoracic lesions after 14 months. All have resumed work. Thirteen other patients were completely paralyzed and showed no postoperative improvement. It seems evident, therefore, that a patient with a spinal cord tumor who has been completely paralyzed for 3 months has better than an even chance for recovery if the tumor can be removed without additional damage to the spinal cord.

As regards mortality and morbidity in this group of 108 patients, 6 had postoperative deaths, 44 were completely cured and 13 were completely paralyzed (5 of the latter are known to be dead).

HOWARD H. LANDER, M.D.

# SURGERY OF THE THORAX

## CHEST WALL AND BREAST

**Primary Rib Tumors.** RALPH A. DORRER and DEANE S. MARCY *J. Thorac. Surg.* 1948, 17, 690.

Primary rib tumors present no clinical characteristics not found in similar tumors occurring elsewhere in the skeletal system. Because of their location, they do present certain diagnostic problems and surgical considerations not found in tumors elsewhere. Pain and tumor are the most important symptoms. Persistent pain is the more reliable and constant finding since tumor may not exist. Pain often develops before a mass is recognizable either clinically or roentgenographically. Wide excision including resection of the periosteum underlying pleura, and adjacent muscles is the treatment of choice for all primary rib tumors.

Seven cases of primary rib tumors in patients operated upon at the State University of Iowa Hospital from 1934 to 1946 are reported. These include a recurrent chondroma, a fibrosarcoma, a chondrosarcoma, an osteochondroma, a fibrous dysplasia, a hemangioma, and an osteoid osteoma.

Fifty five cases of primary rib tumors reported in the literature since Sommer and Major's analysis of 81 proved cases (1942) are tabulated.

FRANK B. QUEEN, M.D.

**Breast Reduction and Lactation.** A. RAGNELL. *Brit. J. Plast. Surg.* 1948, 1, 90.

The author stresses the advisability of employing to the greatest possible extent an operative method based on the transposition of the nipple attached to a gland pedicle in which the milk producing capacity has been preserved on the fullest possible scale. Free grafting in conjunction with amputation on the other hand should be confined to cases in which pregnancy is out of the question or in which earlier pregnancies have not produced lactation as well as those extremely rare cases of breasts of such gigantic proportions as to prevent an ordinary mammoplasty. Pictures of patients operated upon and diagrams of operative procedures are reproduced.

JOHN J. MALONEY, M.D.

**Early Diagnosis and Treatment of Carcinoma of the Breast.** VICTOR RIDDELL. *Brit. M. J.*, 1948, 2, 635.

Only by reducing the delay period both for diagnosis and treatment can the mortality from cancer of the breast be reduced. Among the 170 radical mastectomies performed by the author there were already axillary metastases in 67 per cent of the patients.

A swelling in the breast of any woman in the cancer age should be considered cancer until proved otherwise. Since clinical diagnosis is fallible and the only early sign of cancer is a lump immediate

surgical exploration must be the guiding principle. There is no justification for observation of any doubtful breast lesion. The urgency for investigation is greatest in those patients in whom diagnosis is uncertain because it is with these that the chance of cure is highest.

Delay in hospital admission of suspected cancer cases is wrong too. The names of all early cancer or suspected cancer patients should be placed on a special waiting list, and such patients should be admitted immediately. Exploration of a swelling in the breast should be an emergency operation.

Clinical examination of the breast is important, and should be made with the patient's hands clasped behind the neck so that the breast is tensed to the chest wall. Sometimes if the patient raises her arms straight up above the head a dimple will appear over the affected area, or it may appear upon manipulation of a lump which otherwise appears unattached. The supraclavicular fossae should be examined from behind the patient's shoulders raised and hunched forward so as to throw the fossae into hollows.

The importance of examining for glands behind the anterior axillary fold and well below the level of the axillary outlet (over the second and third intercostal spaces) is emphasized. The frequency of glandular involvement in tumors attached to the skin and the clinical error in the diagnosis of metastasis to glands in 170 radical mastectomies are shown below.

Clinically all cases fall into one of the following broad categories:

Stage 1 tumor only stage 2 tumor and mobile axillary nodes stage 3 disease advanced with local metastases stage 4 disease advanced with distant metastasis.

Stage 1 and stage 2 carcinomas are operable and radical mastectomy should remain the treatment of choice until a better method has been demonstrated. In certain late stage 2 cases it is recommended that

TABLE I — FREQUENCY OF ATTACHMENT OF TUMOR TO SKIN IN 170 PATIENTS

	Glands involved	Glands free
Tumor attached to skin (74%)	79 per cent	21 per cent
Tumor unattached to skin (26%)	5 per cent	40 per cent

TABLE II — THE IMPALPABLE GLAND AND THE CLINICAL ERROR IN 170 PATIENTS

	Glands involved	Glands free
Clinically palpable (6%)	70 per cent	30 per cent
Clinically impalpable (94%)	90 per cent	10 per cent

simple mastectomy with axillary irradiation be seriously considered—particularly if there is present a combination of two or more adverse factors such as rapid growth, wide involvement of the skin by infiltration or ulceration age of over 65 or peripherally situated tumors of the inner hemisphere.

Stage 3 and stage 4 carcinomas are inoperable, although in special circumstances simple mastectomy may be indicated. Stage 3 comprises the group with enlarged supraclavicular nodes on either side, fixed axillary nodes, immobile or fixed axillary nodes on both sides, deep fixation of the breast to the ribs, secondary nodules of the skin, or edema of the arm. In these, symptomatic roentgen therapy is of value. Patients with stage 4 carcinoma should receive hormone therapy or roentgen therapy for symptomatic relief.

The collected operative mortality of 33 British surgeons among 11,044 radical mastectomies is cited as 1.65 per cent. The persistence of malignant cells in the axillary glands of patients given roentgen therapy alone was found by Adair in 1943 to be 93 per cent, and by Richards, in 1948 to be 65 per cent.

It is emphasized that there is no outward visible change in the appearance of the breast in early malignant disease and that lump is the only early sign of breast malignancy.

FRANK B. QUINN, M.D.

**Simultaneous Evolution and Involution of Breast Carcinoma and Warts of the Mammary Region** (*Évolution et involution simultanées de carcinomes du sein et de verrues de la région mammaire*). ARON J. JOSEPH, MARCEL DARGENT and MARCEL MAYER. *Presse méd.* 1948, No. 57, 674.

This is a case report from the Centre Anticancerieux at Lyons, France.

A patient, 35 years of age, had been suffering for a year from a tumor of the superior outer quadrant of the breast without adenopathy. The lesion was first considered as Reclus' disease and treated with androgenic hormones. As the condition became much worse under the treatment, hormonal therapy was discontinued. About the same time, the patient became pregnant, the tumor grew considerably axillary lymph nodes became palpable, and, beginning at the sixth month of pregnancy numerous warts developed on the skin of the affected breast.

At this time the diagnosis of carcinoma of the breast was made, apparently without biopsy and the prognosis was considered as very grave although the general condition of the patient remained good. No treatment was attempted during the pregnancy.

After delivery the tumor which at term had changed the breast into one hard solid mass, showed surprisingly fast spontaneous involution, the axillary lymph nodes decreased in size, and the warts disappeared. Lactation was maintained by the breast pump for 3 months to further the involution of the tumor. Then hemithoracotomy was started. Only 3 months later i.e., 1 year after the carcinoma

had been diagnosed, was the breast amputated. Histologic examination of the lesion revealed an atypical acanthoma.

The authors discuss the danger of hormonal treatment, especially with insufficient doses. In this case, the hormonal treatment obviously precipitated the growth of the tumor.

Furthermore, the authors emphasize the danger of any active treatment of breast carcinoma during pregnancy. A survey made at the Centre Anticancerieux proved that no treatment at all during pregnancy gives a better prognosis as to survival than any kind of treatment. After delivery lactation should be maintained by the breast pump as lactation has a beneficial effect on the involution of the tumor. Nursing, however, is contraindicated because of the carcinogenic milk factor. After cessation of the lactation, the patient should be sterilized with x-rays and only after the sterilization should the breast be amputated. Although, in this case, the time interval is too short for final judgment, the patient appeared clinically cured 1 year after the beginning of the treatment, whereas in cases actively treated during pregnancy recurrences and metastases occur in an explosive way within 6 months after delivery.

WALTER M. SOMMER, M.D.

**Carcinoma of the Breast and Its Treatment.** See CROOK WAXLEY. *Br. J. Surg.* 1948, 2, 632.

In this general discussion it is emphasized that (1) the single early sign of cancer of the breast is the presence of a lump (2) the commonest cause of a lump in the breast is cancer (3) a lump must be removed in its entirety for histologic examination, (4) there is no lymphatic connection between the breast and the supraclavicular glands except via the upper intercostal spaces, and none between the axillary and supraclavicular glands. Involvement of supraclavicular glands, therefore means that intrathoracic extension has taken place and the lesion is inoperable.

The treatment recommended depends upon the clinical stage of the disease. In stage 1 cases (tumor in the breast only) radical excision is recommended however if the woman is slight and the tumor is in the inner quadrant of a small breast, local excision followed by radiotherapy is advocated.

In stage 2 (tumor of the breast with skin changes, and/or involvement of the axillary glands) preoperative irradiation followed by radical mastectomy is recommended. Postoperative irradiation is reserved for patients in whom the condition has recurred.

In stage 3 (tumor of the breast and supraclavicular glands, or with fixation of the breast) palliation with roentgen therapy is the treatment of choice. In stage 4 (skeletal and visceral metastases) appropriate symptomatic therapy only is recommended.

An 81 per cent 5 year cure and a 65 per cent 10 year cure is obtained in stage 1 cases, while only a 25 per cent 5 year survival is obtained in stage 2 cases.



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The authors discuss the danger of hormonal treatment, especially with insufficient doses. In this case, the hormonal treatment obviously precipitated the growth of the tumor.

Furthermore, the authors emphasize the danger of any active treatment of breast carcinoma during pregnancy. A survey made at the Centre Anticancéreux proved that no treatment at all during pregnancy gives a better prognosis as to survival than any kind of treatment. After delivery lactation should be maintained by the breast pump as lactation has a beneficial effect on the involution of the tumor. Nursing, however, is contraindicated because of the carcinogenic milk factor. After cessation of the lactation, the patient should be sterilized with x rays and only after the sterilization should the breast be amputated. Although, in this case, the time interval is too short for final judgment, the patient appeared clinically cured 1 year after the beginning of the treatment, whereas in cases actively treated during pregnancy recurrences and metastases occur in an explosive way within 6 months after delivery.

WILHELM M. SCHULTZ, M.D.

**Carcinoma of the Breast and Its Treatment.** Sir Cecil WAKLEY. *Brit. M. J.* 943, 2: 651.

In this general discussion it is emphasized that (1) the single early sign of cancer of the breast is the presence of a lump (2) the commonest cause of a lump in the breast is cancer (3) a lump must be removed in its entirety for histologic examination, (4) there is no lymphatic connection between the breast and the supraclavicular glands except in the upper intercostal spaces, and none between the axillary and supraclavicular glands. Involvement of supraclavicular glands, therefore, means that intrathoracic extension has taken place and the lesion is inoperable.

The treatment recommended depends upon the clinical stage of the disease. In stage cases (tumor in the breast only) radical excision is recommended, however. If the woman is slight and the tumor is in the inner quadrant of a small breast, local excision followed by radiotherapy is advocated.

In stage 2 (tumor of the breast with skin changes, and/or involvement of the axillary glands) preoperative irradiation followed by radical mastectomy is recommended. Postoperative irradiation is reserved for patients in whom this condition has recurred.

In stage 3 (tumor of the breast and supraclavicular glands, or with fixation of the breast) palliation with roentgen therapy is the treatment of choice. In stage 4 (skeletal and visceral metastases) appropriate symptomatic therapy only is recommended.

An 81 per cent 5 year cure and a 65 per cent 10 year cure is obtained in stage 1 cases, while only a 25 per cent 5 year survival is obtained in stage 2 cases.

Nine cases of cancer of the male breast are reported. All patients died of mediastinal metastases. The average duration of life after operation was 30 months.

FRANK B. QUEEN, M.D.

**Cancer of the Breast and Gestation** (Cancer du sein et grossesse) JEAN PIERROTIN *Presse méd.* 1948, 56 659.

Thirteen unpublished reports of cancer in the course of gestation and 29 collected from the literature are reviewed by the author.

In 23 of the cases the condition was noticed during the pregnancy and in 10 during the lactation period and in 9 there was a recurrence of cancer with pregnancy. In 19 instances cancer was discovered in the early stages of gestation in 7 at about the fifth month and in 4 toward the end of the gestation period. Recurrences were recorded only in pregnant women before delivery and not during the lactation period. The youngest patient was aged 20 and the oldest 50 years. No correlation could be discovered between the occurrence of cancer and the number of preceding pregnancies. Approximately 50 per cent of all the women had been nursing before the development of cancer. In 20, some other lesion in the breast preceded the development of cancer viz. a benign tumor in 14, an inflammatory lesion in 4, a traumatic lesion in 1 and persisting galactorrhea in 1. Apparently pregnancy creates conditions favorable to a malignant degeneration.

Multiple nodules were found in 8 per cent of the entire group and bilateral involvement in 25 per cent.

Three aspects of cancer observed in the course of gestation may be distinguished: acute carcinomatous mastitis, a subacute pseudoinflammatory form, and a nodular form. No special pathologic-anatomic features characterize the cancer found in the course of gestation.

Radical breast amputation was employed in 15 cases, a 5 year survival period was recorded in 2. Of 7 patients treated with x rays only 6 developed recurrences within 1 year.

Radical surgery followed by x ray therapy was employed in 7 patients. The average survival period was 21 months. In 4 patients this mode of therapy was supplemented by castration. The author considers a radical mastectomy followed by x ray therapy as the method of choice. Castration which suppresses the ovarian activity and especially the secretion of folliculin deserves attention. If the malignant condition is discovered within the first 4 months of gestation and is in an early stage, a therapeutic abortion should be taken into consideration. The abortion should follow and not precede the amputation of the breast. A cesarean section should be considered if the malignant condition is discovered toward the end of the gestation period and the mother's condition is such as to create danger of the death of the fetus in utero. The section should be supplemented by a bilateral castration.

The prenatal care should include a careful examination of the breasts. JOSEPH K. NARAT, M.D.

## TRACHEA, LUNGS, AND PLEURA

**Congenital Tracheoesophageal Fistula without Esophageal Atresia** CAMERON HIGHT *J. Thorac. Surg.* 1948, 17 600.

Congenital tracheoesophageal fistula without other esophageal lesions is of very rare occurrence, and only some 6 to 10 cases have been reported. Atresia of the esophagus is much more common and some 500 cases of congenital atresia have been reported. During the past 12 years atresia has been observed in 63 infants at the University of Michigan Hospital, Ann Arbor, but tracheoesophageal fistula with no other lesion of the esophagus was observed in only 2, an incidence of about 3 per cent of all congenital esophageal lesions.

Diagnosis of fistula unaccompanied by atresia is difficult to establish. Esophagoscopy and bronchoscopy are useful and if the fistula cannot be seen bronchoscopy following a swallow of colored fluid such as methylene blue is suggested as an aid. Roentgenography should be done in the prone position so that iodized oil will readily pass from the esophagus into the trachea. A suggestive, although not a diagnostic roentgenologic sign is the presence of an unusually large amount of air in the stomach or duodenum. Surgical closure of the fistula is recommended as soon as it is diagnosed.

A detailed case report of the closure of a congenital tracheoesophageal fistula in a 4 year old boy with no other lesion in the esophagus is given. There is but one other such case reported in the literature.

FRANK B. QUEEN, M.D.

**The Management of the Pulmonary Coin Lesion** E. J. O'BRIEN, WILLIAM M. TUTTLE, and JOSEPH FERRANTY *Surg. Clin. N. America* 1948 28 1313.

Because of the high incidence of malignancy and inadequacy of diagnostic methods in rounded tumors, or 'coin lesions' appearing in the lung parenchyma, a radical attitude toward their treatment appears justified. Such tumors may be (1) malignant or benign tumors, (2) tuberculosis, (3) chronic indolent abscesses, or (4) metastatic tumors. In 21 cases no definite diagnosis could be made prior to operation. One patient had inoperable carcinoma while 20 patients were subjected to resection. The diagnosis was bronchogenic carcinoma in 8 patients, sarcoma in 1 patient, tuberculosis in 8 patients, cyst in 1 patient, abscess in 3 patients, and chondroma in 1 patient. No patient died as a result of the surgical procedure.

The symptoms of such coin lesions are minimal and the lesions are usually discovered during a routine or incidental roentgen examination of the chest. Of the 21 patients in this series only 10 had symptoms related to the tumor mass: cough and hemoptysis were the most common ones.

Roentgenography, bronchoscopy, and bacteriologic and cytologic examination of the sputum may be entirely inadequate in establishing a diagnosis. To temporize is to waste time and perhaps life. Most

ably oiled or waxed. Small-eyed or atraumatic needles are advised. Free muscle grafts and pericardial reinforcements are suggested.

Ligature the use of metal clips, or both on branches of bleeding coronary arteries is discussed. The sternum when transected should be replaced with firm wiring. W. FORSTER MONTGOMERY, M.D.

**Revascularization of the Heart.** CLAUDE S. BRICK. *Ann. Surg.* 94, 38-854.

A third method for revascularization of the heart is presented. This method consists of arterialization of the sinus. Arterialization of the coronary sinus was accomplished by grafting a systemic artery into the sinus and also by making a new branch from the aorta to the sinus with a free graft of artery or vein.

Arterialization of the coronary sinus is effective physiologically. After anastomosis has been made it is possible to ligate a major coronary artery with little or no mortality and with little or no infarction.

Various problems concerning circulation in the heart in the further study. One patient with severe coronary artery disease was operated upon. A free graft of brachial artery was placed between the aorta and coronary sinus. A fresh infarct developed in the interventricular septum probably at the time of operation. The anastomosis was patent at the time of death 1 day later. JAMES J. MASON, M.D.

**Neoplastic Metastasis to the Heart.** AARO M. LEV KOWITZ. *Am. Heart J.* 94, 36-60.

Metastatic involvement of the heart by tumor growth is not too frequent. The purpose of this article was to record an unusual case and to describe 5 other cases.

The first case reported was that of a 48 year old white male who had had a history of acid catenry of a black mole of the chest. He was first seen with numerous subcutaneous nodules. At this time the heart was enlarged the rhythm was regular the rate was 6 per minute, the sounds were of good quality, the blood pressure was 103/64, and there was a faint systolic murmur over the base. There was x-ray evidence of slight cardiac enlargement. Biopsy of a nodule confirmed the diagnosis of malignant melanoma. The patient died 3 days after admission. A autopsy revealed nodular infiltration over the surface of the heart and over the endocardium. Section of the heart muscle revealed extensive infiltration.

The author reports 5 additional cases, 3 of malignant melanoma, 1 case of bronchogenic carcinoma, and 1 of embryonal carcinoma of the left testicle.

The author points out that the failure to diagnose metastatic disease of the heart is the absence of any characteristic symptoms or signs. In the cases presented tachycardia, otherwise unexplained, was the only constant finding. The electrocardiogram was of no help. The author states that cardiac metastasis should be considered in any patient with malignant disease who has an unexplained tachycardia, even if their heart findings are negative.

ROBERT E. FLOREN, M.D.

**Chronic Constrictive Pericarditis Over the Left Heart Chambers and Its Surgical Relief.** PART II. WHITE, FRED ALEXANDER, EDWARD D. CRITCHFIELD, and RICHARD H. SWEET. *Am. J. M. Sc.* 94, 6: 378.

Three case histories are presented of young adult males who suffered from chronic constrictive pericarditis involving preponderantly the left heart chambers and who required decortication (partial pericardiectomy) for relief. One patient died from a peripheral arterial embolism after two unsuccessful pericardial resections and an omentopexy. The 2 other patients have been greatly benefited by the removal of the pericardium from the left auricle and left ventricle.

In the 3 patients clinical evidence suggested the diagnosis of chronic constrictive pericarditis. An accentuated pulmonary second sound was present. There was cardiac enlargement involving the right ventricle a shift of the electrocardiographic axis deviation to the right and a persistence of chronic congestion. A measurement of the pulmonary blood pressure by cardiac catheterization was an important test of the left heart chambers in 2 of the patients, and the marked elevation confirmed the constriction of the left heart chambers which produced syndrome like that of mitral stenosis in its effect on the pulmonary circulation and the right heart.

ORVILLE F. GARDNER, M.D.

**The Surgical Treatment of the Infantile Type of Coarctation of the Aorta.** JULIAN JOHANSON and CHARLES K. KIRBY. *Ann. Surg.* 94, 7-9.

Coarctation of the aorta may be divided into two types: (1) the infantile type in which there is an elongated narrowing at the isthmus, and (2) the adult type in which there is an abrupt constriction at or near the ductus arteriosus. Because statistics show that 66 per cent of the patients with the adult type of coarctation will die as the result of associated hypertension there seems to be sufficient indication for attempts at surgical correction.

The first operation for coarctation was done by Crafoord of Stockholm in 1914.

The authors report operations on 3 patients with coarctation of the aorta of the infantile type. In all 3 the constricted area extended over a distance of several centimeters. In each it was possible to perform the type of operation used by Crafoord or Gross so attempts were made (successful in 2 of the 3) to turn the left subclavian artery down to bridge the defect.

The cases are reported in detail. The first patient obtained a good result with return to normal of the blood pressure in the upper extremities. The second patient's systolic blood pressure did not fall although the diastolic pressure returned to normal.

It was necessary to abandon the operation on the third patient because of the friability of the vessels due to atheromatous changes.

In the infantile type of coarctation, excision of the area and end-to-end anastomosis will probably never



be feasible. If the subclavian artery is to be used the question will always arise as to whether the blood flow is materially increased by the procedure.

The problem of age and the decision to operate present several problems. If done too early there is some question as to whether the site of anastomosis will grow with the patient. If it is done too late the vessel wall may be so friable as to make suture hazardous. The period between the ages of 12 and 14 years would seem to be the most satisfactory one for operation.

W. FOSTER MONTGOMERY, M.D.

## ESOPHAGUS AND MEDIASTINUM

The Treatment of Congenital Atresia of the Esophagus from a Technical Point of View. PH. SANDBLOM. *Acta chir. scand.*, 1948 97 25

Congenital esophageal stenosis is less common than esophageal atresia. Although most instances of esophageal atresia are associated with tracheoesophageal fistula and are quite similar, esophageal stenoses take various forms and occur at all levels of the esophagus. The two conditions are probably caused by different developmental defects, atresias arising at an early stage when the fetal lung buds are separating from the fore gut and stenoses occurring at a later period when the digestive canal has become a solid epithelial structure. Stenoses are believed to develop much in a manner comparable to intestinal atresias.

Findlay in a collected series of 80 cases classified four types of esophageal stenoses:

1. Narrowing of the lumen or constriction of the esophagus for a short distance. This is attributed to failure of opening of the esophageal wall in development.

2. A membranous diaphragm believed due to a failure of proper channelization of the solid epithelial cord so that a portion of it persists as a diaphragm with a large or small opening located either centrally or eccentrically.

3. Localized fibrous or fibromuscular thickening of the wall of the esophagus of unknown etiology.

4. Spasm, a lack of proper co-ordination of the esophageal muscular activity. Cardiospasm is the most common example of this. Although some investigators have claimed a structural change in Auerbach's plexus with this disorder, the etiology in general is regarded as unknown.

Usually the proximal portion of the esophagus becomes dilated and hypertrophied, and in some instances a diverticulum may form.

Dysphagia and regurgitation are the manifestations of esophageal stenosis; the latter usually occurring in direct association with food ingestion. If food remains within the esophagus inflammatory changes often occur with exacerbations of symptoms. Acute aggravation of the symptoms is also found in catarrhal conditions which cause swelling of the mucous membranes.

In the very pronounced stenoses, symptoms may be present from birth, but in less severe cases they

do not arise until the child commences to take solid food. In those cases in which symptoms begin at a later date, it is probable that a less severe stenosis exists which is increased by some inflammatory process in later life. In these instances it is difficult to establish definitely whether the stenosis is of congenital origin.

When esophageal stenosis is suspected a barium swallow and endoscopy should be done. Differential diagnosis includes traumatic and chemical stricture, a congenitally short esophagus (which may be distinguished by the presence of gastric mucosa within the chest below the point of narrowing), and cardiospasm with hypertrophy of the musculature proximal to the site of the lesion.

Early treatment involves a dietary regimen with avoidance of solid foods and dilatation by bougies sometimes complemented by division of an obstructing membrane at endoscopy. Such treatment as this is effective only in those cases with a membranous diaphragm, and usually does not appreciably help a fibromuscular stricture or long area of narrowing. In these cases surgical intervention is indicated. This is easiest when the stricture is located very high or low. As early as 1892 Brenner described a case of high esophageal stenosis in which he effected a widening of the stenosis and closure of a tracheoesophageal fistula by esophagotomy. Others have successfully operated on stenoses above the cardia by the transabdominal approach. There have been a few patients with stenoses located in the middle third who were cured by operation.

The report of a 10 month old girl who had vomited frequently since birth is given. Following an attack of pharyngitis at the age of 9 months her dysphagia increased markedly so that she was unable to swallow any food or fluids. Roentgen examination after the ingestion of barium paste showed a stenosis at the junction of the lower and middle thirds of the esophagus. The esophagus was distended both below and above this point. Because of the rigidity and firmness of this stricture, no attempt at dilatation was made, but surgical intervention was advised.

Under endotracheal anesthesia a right posterior retropleural approach was used with a vertical incision between the spine and scapula. The pleura was reflected medially and the azygos vein and vagus nerve were divided to facilitate approach to the region. At the junction of the middle and lower thirds of the esophagus there was a fibrous induration of the esophagus about 1.5 cm. in length. This was corrected by a Heineke-Mikulicz plastic procedure which consisted of making a vertical incision and closing it transversely. Before the incision was closed a sound was passed through the esophagus to ascertain that no other strictures were present. After suturing was completed saline solution was injected to determine the adequacy of the repair. The operative field was drained and the wound cavity filled with penicillin solution. On the following day a Wittel gastrostomy was done. The postoperative course was uneventful. Oral ingestion was begun on

the fourteenth day and the gastrostomy was closed 5 days later. One month after the operation semiliquid food could be swallowed without difficulty. Roentgen-ray examination 6 months later showed a dilated wide passage at the site of the old stenosis but a marked narrowing just above the cardia. Endoscopy revealed a membranous fold at this location. This was dilated and there was complete relief of the dysphagia. Ten months after the first operation, x-ray examination showed no obstruction in the esophagus.

The author considers the retropleural approach better than the transpleural route since the dangers of an opened cavity are avoided. He advises the use of a Heineke-Mikulicz procedure when feasible rather than an anastomosis. The testing of esophageal suture by the injection of saline solution into the esophagus under pressure is advocated. A stenosis of greater length than in the patient presented here should be resected with an end-to-end esophageal anastomosis or an esophagogastrostomy.

C. FREDERICK KITTLE, M.D.

**Spontaneous Rupture of the Esophagus.** JULIAN A. MOORE and JAMES D. MURPHY. *J. Thorac. Surg.* 945, 17: 632.

The difficulties in diagnosis and surgical management of spontaneous rupture of the esophagus are illustrated in the case presented, in which the authors report a recovery. The first impression was that of a ruptured peptic ulcer and the laparotomy performed revealed no pathology. Attention was centered on the left thorax during the postoperative period and a perforated ulcer in the stomach (which was found herniated through the diaphragm) was suspected. The rupture of the esophagus was discovered at the time of the transthoracic operation for correction of the hernia and drainage of an empyema. A rent 4 cm. long was present in the anterolateral esophagus just above the diaphragm and an esophagogastroplasty was performed by means of silk sutures. A jejunostomy was used for feeding. Penicillin was given intramuscularly. The postoperative convalescence was uneventful, and roentgenograms taken 3 and 4 months following surgery showed the stomach

in the abdomen, the lung re-expanded, and a normal appearing esophagus. The patient was discharged completely recovered 5 months after the rupture of the esophagus had occurred.

The diagnosis of rupture of the esophagus is to be suspected when there is severe upper abdominal pain associated with vomiting, particularly of blood, and especially when this is accompanied with cervical emphysema and pneumothorax. Roentgen findings of a pocket of gas behind the heart are considered a diagnostic aid by the authors.

Treatment should include drainage of the thoracic cavity, jejunostomy for feedings, intravenous fluids to supplement jejunostomy feedings and adequate antibiotics. The esophagus should be repaired only when the patient's condition permits.

W. HARRISON MEEK, M.D.

**Benign Pedunculated Tumors of the Esophagus.** RAYMOND C. BECKER, JAMES V. COLLINS, and MARTIN F. HALL. *Am. J. Roentg.* 1948, 60: 466.

Benign pedunculated tumors of the esophagus are rare and may be encountered unexpectedly on routine examination since symptoms may be mild or absent. Those in the upper third of the esophagus are single and arise in the region where esophageal diverticula commonly have their origin; those in the middle and distal thirds may be multiple. The single tumors which arise in the uppermost portion of the esophagus occur as a result of the greater elasticity of the esophageal mucous membrane in this region. The tumors are smooth, variable in size, and may have multiple projections. Histologically they are usually fibrolipomas. The diagnosis can be made roentgenologically if such a tumor is suspected. Occasionally the tumors present in the mouth and the diagnosis is then obvious.

A case is reported of a 70 year old male with upper esophageal symptoms of 12 years duration. The bifid pedunculated tumor could be regurgitated into the mouth and then swallowed. It was successfully removed under direct vision through the oropharynx and the patient was asymptomatic when seen 4 years later.

JEROME E. THOMPSON, M.D.

# SURGERY OF THE ABDOMEN

## ABDOMINAL WALL AND PERITONEUM

**The Treatment of Primary and Recurrent Inguinal Hernia by Skin Graft (El tratamiento de las hernias inguinales primarias y recidivadas con injerto de piel)** VICENTE F. PATARO and DIEGO E. ZAVALLETA. *Dis MEd.*, B Air 1943, 30: 2350.

Irrespective of the surgical method employed hernial recurrence is high and the results for the most large hernias by the cutaneous graft technique recommended its use. Indications include repair of large hernias in which there is disintegration of the anatomic elements repair of certain primary hernias in which radical surgical cure is likely to be disappointing recurrent hernias and postoperative eventration.

After careful preparation of the skin an elliptical incision of the skin is made over the hernia (roughly 5 by 2.5 cm). The upper apex is squared off and the skin cut longitudinally down the center sufficiently far enough to permit the passage and enclosure of the cord. The skin is then sutured as a collar about the cord and the margins are attached to the internal muscular border to Poupart's and Cooper's ligaments and to the symphysis pubis care being taken to keep the tension uniform. The cord is consequently displaced and the skin flap constitutes the floor of the inguinal canal. The principle is the same in recurrent hernias however the source of the graft may be remote.

In the 59 cases in which the method was employed the results were most encouraging.

STEPHEN V. ZIEMAN, M.D.  
*Brit M J* 1943, 2: 743.

**A Review of Femoral Hernias.** ANDREW G. BUTLER. *Brit M J* 1943, 2: 743.

The author reviews the cases of 178 patients with femoral hernia who were operated upon in the period from 1942 to 1946 at the Royal Hospital in Sheffield.

Of 160 patients all were operated upon by the low method for femoral hernia repair. There were no recurrences among the 54 male patients but 4 recurrences among the 66 females. No increased likelihood of recurrence could be demonstrated in the aged as compared with the young in relation to heavy work or chronic cough or in relation to straining. However, 7 per cent of the patients subsequently developed inguinal hernia on the same side as the femoral repair.

The chief cause for recurrence was found to be failure to remove the sac adequately. There is a tendency to transfuse the sac too low down and to retract through the femoral canal.

The author concludes that the low operation is suitable for almost every case and gives the most satisfactory results.

EDWARD W. GIBBS, M.D.

**Repair of Femoral Hernia with a "Postage Stamp" Fascial Graft.** H. A. KIDD. *Brit M J* 1943, 2: 745.

A method is described for the repair of femoral hernia with a fascial flap. The principle of the operation is to cut a rectangular section of external oblique aponeurosis and let the attachment to Poupart's ligament remain intact and then swing this section down so that the free margin can be sutured to the peritoneum of the pubic ramus and thus close the femoral canal by a trap door of living fascia.

The author reports on 53 repairs by this method with 2 recurrences. Two patients subsequently developed direct inguinal hernia.

EDWARD W. GIBBS, M.D.

## GASTROINTESTINAL TRACT

**Polypoid Adenomatosis of the Entire Gastrointestinal Tract.** MARK M. RAVITCH. *Ann. Surg.* 1943, 128: 283.

Two interesting cases demonstrating polypoid adenomatosis of the entire gastrointestinal tract are reported.

The first case was that of a white male infant who was seen initially at the age of 10 months. From birth he had suffered diarrhea with numerous large foul stools containing unchanged food. Duodenal enzyme studies did not support a diagnosis of cystic fibrosis of the pancreas but a rectal prolapse exposed many polypoid tumors of the rectal mucosa. Gastrointestinal roentgenograms finally showed numerous polyps in the colon but none in the small intestine. At the age of 18 months he was operated upon for intussusception which was resected. Many polyps were felt in the small bowel above the intussusception and many polyps were found in the resected ileum. Death occurred 24 hours after operation. The autopsy revealed that the entire gastrointestinal tract was involved by innumerable polyps with no uninvolved areas intervening.

The second case was that of a 16 year old white girl whose history revealed that at the age of 6 she presented complaints of bloody stools anemia and abdominal pain and at operation two widely separated intussusceptions of the small bowel both associated with polyps were reduced and the polyps excised. Another laparotomy was performed at the age of 14 for the division of obstructing bands of adhesions. Sigmoidoscopic and repeated roentgen studies of the entire gastrointestinal tract were negative. At the last hospital admission she was found to have a severe secondary anemia blood in the stools and frequent abdominal cramps. Sigmoidoscopy revealed two small rectal polyps but gastro-intestinal roentgenograms failed to reveal any polyps. At operation two large polyps were removed from

the stomach by gastrotomy a 100 cm. long segment of jejunum containing eight large pedunculated polyps was excised, and end-to-end anastomosis was performed. Recovery from the operation was smooth and the patient was discharged. An interesting feature of this case was the observation of pigmentation of the buccal mucosa.

**Polypoid adenomatosis of the colon.** In true polypoid adenomatosis, the colon is the seat of innumerable polyps and the disease is familial and inevitably results in the development of cancer in one or several of the adenomas. This is in contradistinction to patients who have only a few six or eight, polyps of the colon. The latter disease is not familial and the development of cancer not so certain consequently treatment can be less radical in that excision of the polyps alone will be adequate. True polypoid adenomatosis should be treated by total colectomy with a permanent ileostomy.

**Polypoid adenomatosis of the small intestine.** Adenomatosis of the small intestine is familial only occasionally and malignant degeneration is uncommon. It is characterized clinically by abdominal discomfort which is frequently of an obstructive nature and leads to operation for the correction of intussusception. Some of the patients have pigmentation of the buccal mucosa, which has been found to be associated with intestinal polyps. Treatment consists of resection of the intussusception segment containing polyps. At operation, if all the polyps are in one segment, it should be resected but if the entire small intestine is involved, only the offending areas are resected.

**Polypoid adenomatosis of the stomach.** Polyps of the stomach may be peculiarly silent, although they may cause indigestion, melena, hematemesis, or obstruction. Malignant degeneration may be as frequent as in polypoid adenomatosis of the colon, and the two are frequently associated. Roentgenograms are frequently negative. The treatment of choice is radical gastrectomy when polyposis does not exist elsewhere in the gastrointestinal tract.

**Polypoid adenomatosis of the entire gastrointestinal tract.** This condition is rare and only a substantiated cases have been found which are similar to the case first presented in this report, in that adenomatosis carpeted the intestinal tract from the cardia to the anus. There were 1 additional cases in which each segment of the intestinal tract, beginning with the stomach had at least a few polyps. All these cases are described.

**Polypoid adenomatosis of the small and large intestine.** There are a number of reports of adenomatosis with this distribution of lesions. The histories combine the pain and repeated intussusception of adenomatosis of the small intestine with the diarrhea and malignant degeneration of adenomatosis of the large intestine. The condition usually is not familial. In the absence of a familial history in patients with adenomatosis of the colon the small intestine must be explored before a colectomy is performed. If adenomas are widespread and numerous the condi-

tion is therapeutically hopeless. However resection may be feasible if the tumors involve only a few bowel segments of limited extent or if only a few large polyps are scattered about. A number of these cases are described. ERNEST D. BLOOMENTHAL, M.D.

**Follow Up of Vagotomy Plus Gastroenterostomy or Pyloroplasty for Ulcer.** E. N. COLLINS, GEORGE CRILEY, JR. and J. B. DAVIS. *Gastroenterology* 94, 151-153.

During the past 28 months the authors have studied 240 patients who have been subjected to bilateral vagotomy at the Cleveland Clinic Hospital. Of these, 129 patients have undergone bilateral transabdominal vagotomy for either a duodenal or jejunal ulcer, in addition to which some ancillary procedure, such as gastroenterostomy or pyloroplasty was added to facilitate the emptying of the vagotomized stomach.

The percentage of follow-up studies was excellent and the shortest follow-up period was 5 months, the longest 28 months, and the average 11 months. Jejunal ulcers occurring after gastric resection were not considered in this study.

The authors conclude that an experience of many years is necessary before a final appraisal of this or any other form of treatment for peptic ulcer is conclusive. They state that approximately 85 per cent of their patients with duodenal ulcer are considered to be satisfactory candidates for medical management alone. The group of patients presented in this report were those who had not made satisfactory progress on a medical regimen and were therefore subjected to surgery.

One death occurred in the entire group of 84 cases. Of the remaining 83 patients, all had intractable pain and 39 had had gastric hemorrhage as well. Eight patients had had bowel perforation, multiple in 3 and 27 patients had symptoms of pyloric obstruction. The authors conclude that in their experience the patients having complicated duodenal or jejunal ulcers have shown better results following vagotomy than a comparable series of patients undergoing gastric resection or gastroenterostomy alone, the follow-ups being made over a similar period of time.

None of the patients subjected to operation has as yet developed any objective evidence of a recurrent ulcer. No patient has developed a jejunal or marginal ulcer at the site of the gastroenterostomy or pyloroplasty. It is the feeling of these surgeons that when surgery is indicated for complicated duodenal or jejunal ulcer bilateral vagotomy plus gastroenterostomy or pyloroplasty is the procedure of choice.

EDWARD F. LEWIS, M.D.

**Management of Massively Bleeding Peptic Ulcer.** JOHN D. STEWART, SIDNEY M. SCHALL, WILLIAM H. POTTER, and ALFRED J. MANSOYER. *Ann. Surg.* 1948, 128, 79.

The authors report their experience in the treatment of massively bleeding peptic ulcer by imme-

diate large blood transfusions and early gastric resection. Their series consisted of 54 patients 33 of whom were operated upon and 21 of whom were treated as control cases without operation.

By early operation the authors mean subtotal gastric resection within 24 hours of admission to the hospital by acute massive hemorrhage they mean the vomiting of blood or passage of blood by rectum within one week of admission the hemorrhage being severe enough to depress the red cell count to 2.5 million per cubic millimeter or less or to reduce the circulating red cell volume to 60 per cent of normal or less. The average interval between admission and operation in the operative series was 9.3 hours. At operation a subtotal gastric resection was performed, an antecolic Hoffmeister anastomosis was made and 80 per cent of the stomach was removed. The authors do not use x rays as a diagnostic aid in these cases.

The patients operated upon received an average of 3 600 c.c. of blood as compared with 2 030 c.c. for the control group. The author emphasizes that despite such large amounts of transfused blood the hemoglobin values remained at less than 75 per cent of normal. The authors found that at the end of 24 hours 22 per cent of the administered hemoglobin had left the circulation and at the end of 15 days 35 per cent of it was missing. There was no evidence of hemolysis in these cases to explain the figures and the author concludes that much larger amounts of blood are required in the replenishment therapy of hemorrhage than is usually realized. Elevation of the blood sugar was found to be the rule in the hemorrhagic state and this seems definitely related to the diminished amount of liver glycogen found by liver biopsies on these patients.

In these series the mortality rates were as follows for the 33 patients treated surgically 5 deaths or a 15 per cent mortality and for the 21 patients not operated on, 6 deaths or a 29 per cent mortality. The author states that while the series is hardly large enough to warrant statistical analysis all the men concerned in the work believe that more lives are saved by early adequate blood replacement and gastric resection than by the nonsurgical plan of treatment.

F. J. LUDMANN, JR., M.D.

**The Prognosis and Treatment of Massive Hemorrhage from Gastric and Duodenal Ulcers.** ERIC D. BARTLE, *Acta med scand* 1948, 131 Supp 213 p. 65

For this report 31 cases of fatal hematemesis and melena from all causes and 34 cases of fatal bleeding from gastric or duodenal ulcer or gastritis were studied. The patients were chiefly elderly or old people. The differential diagnosis is not easy in these cases and may occasionally only be made by x ray examination.

It was concluded that life threatening hemorrhage from the gastrointestinal canal should be regarded as due to a benign disease and treated accordingly until malignancy is proved. The treatment of acute gas-

tric hemorrhage should in the first instance be one of rest, confinement to bed and from the very beginning a diet rich in protein and fluid the form of which is of minor importance. The first few days one should be on the lookout for shock symptoms and if such occur give large and frequent blood transfusions as well as morphine. The salt and electrolyte balances should be carefully watched.

It is essential that the exact cause of the hemorrhage and the severity of possible complications be ascertained as soon as possible. If the diagnosis is one of gastric or duodenal ulcer and profuse hemorrhage persists for more than from 36 to 48 hours in a patient without severe complications roentgen examination should be made and operation considered particularly if the patient is in the age group between 50 to 70. In younger patients the hemorrhage will nearly always stop spontaneously.

The author is of the opinion that about one third of the patients in the present series might perhaps have been saved if the principles discussed had been carried through. The remaining two-thirds were so ill from other diseases or complications that probably no treatment would have saved them.

JOHN L. LUDQUIST, M.D.

**Considerations on 941 Interventions for Gastro-duodenal Perforations (Considerazioni su 941 interventi per perforazioni gastro-duodenali).** LEONIDA MANIACCHI, *Chirurgia* 1948, 3 105

All cases of gastroduodenal perforation occurring from 1934 to 1947, at the Polyclinic Hospital in Milan are analyzed by the author. During this time 941 patients were seen and operated upon by a group of 80 surgeons. There has been an increasing number of gastric resections performed in the later years for perforated peptic ulcer. In 1939 and 1944 there were no resections performed and the mortality was 9.9 per cent and 14.8 per cent respectively. In 1947 the over all mortality was 7.5 per cent. During this year 22 or 33.8 per cent of 65 cases of perforated ulcer were resected with a mortality of 4.5 per cent. In 1934 the mortality for gastric resection in perforated ulcer was 60 per cent. The improvement is the result of treatment for shock and the use of sulfonamides and penicillin. With proper treatment for shock plus the use of sulfonamides and penicillin the period within which resection can be carried out has been extended as far as from 16 to 18 hours after perforation has occurred.

The author believes that gastric resection for perforated ulcer should be used more and more. Simple suture is resorted to only in cases in which gastric resection would not be used were it an elective procedure as in cardiacs, diabetics or in cases of grave and persistent shock. The author believes that gastric resection is indicated particularly in perforation of marginal ulcer in which the mortality is less than for simple closure.

The use of drainage has been eliminated with improvement of the results especially since the advent of sulfonamides and, better still, penicillin. Fewer

postoperative complications are encountered since the general use of local anesthesia has been resorted to, in preference to general or spinal anesthesia.

LOUEAN J. FROMMERT, M.D.

**Gastric Resection: The Schoemaker Billroth I Operation.** JOHN F. HIGDON and O. TIERSON. *CLARK'S Surgery* 948, 24, 6-3.

The purpose of the authors' presentation was to consider (1) the Schoemaker modification of the Billroth I operation, (2) some of the reasons why when feasible, this operation seems better than the Hofmeister Polya operation (in which the treatment of the stomach is the same but reconstruction of continuity of the intestine is different), and (3) the immediate results in 95 cases in which the Schoemaker Billroth I technique has been used.

The Billroth I types of gastric operation are the most logical in so far as reconstruction of continuity of the alimentary tract is concerned and, of these, the Schoemaker modification is one of the easiest to perform, permits wide resection when desired and yields the most nearly natural gastroduodenal continuity and relationship.

The Billroth I type of gastric operation has been much neglected in favor of the Polya forms of the Billroth II type. This neglect is largely the result of operations for duodenal ulcer for which only a Billroth II type of anastomosis is possible in most instances. However it also has resulted from the general use of the full Polya anastomosis in cases of gastric carcinoma as well as duodenal ulcer. In this procedure the straight across transection and use of the full mouth for anastomosis make a gastro-junoostomy almost mandatory. Only occasionally can a von Haberer Billroth I operation be done with such a gastric stump, and then only if the duodenum is unusually large and mobile.

It is naturally true and obvious that a Schoemaker Billroth I operation cannot always be done, because of a fixed or immobile duodenum, a fixed stomach, a stenosed or inflamed duodenum, or because resection along the greater curvature of the stomach is of necessity high. However the various duodenal and gastric features must be evaluated and considered in each case. This is well illustrated in the extreme in those cases in which esophagoduodenostomy has been possible after total gastrectomy.

From a physiologic standpoint the narrow stoma of a Schoemaker Billroth I or a Hofmeister Polya anastomosis seems better than the wide stoma of a full Polya anastomosis. The Schoemaker Billroth I anastomosis seems better than the Hofmeister Polya. The small stoma and the reconstruction of normal continuity by gastroduodenostomy seem to return the duodenum and stomach as nearly as possible to normal physiologic activity.

It might be argued that the small stoma resulting from use of the Schoemaker Billroth I or the Hofmeister Polya technique predisposes to a greater incidence of postoperative gastric retention than does the larger stoma of the posterior Polya operation.

It is possible also that this is more marked after the Schoemaker Billroth I operation than after the Hofmeister Polya.

If, however, clinical impressions as to comfort, maintenance of body weight, and degree of post-prandial distress are confirmed by factual laboratory studies (as they seem to be so far) then the order of preference, when possible, would seem established for these methods of gastric resection.

Immediate results in 95 cases in which the Schoemaker Billroth I technique has been used are given in the complete article.

**The Appraisal of Patients After Gastric Resection During the War (Die Bewachung Magenresezierter in Kriessansten).** R. BOLLER and D. MÜNCHHAUSEN. *Wien. med. Wochs.*, 1943, 95, 455.

In 1943 the authors made an attempt to contact 931 patients operated on during the period from 1916 to 1940. This group consisted of patients with non-malignant lesions of the stomach, operated on according to the Billroth II method. The Hofmeister Flosterer modification was employed nearly exclusively.

The diagnosis was ulcer in 95 per cent and gastritis in 5 per cent of the cases.

Ninety-seven patients, or 10.5 per cent, of the entire group were dead in 1943, while 632 appeared for a check-up. Sixty-eight per cent of them had had a duodenal ulcer, 23 per cent a gastric ulcer, 5 per cent gastritis, 3 per cent both a gastric and a duodenal ulcer and 3 per cent a jejunal ulcer.

The indications for operation were as follows: hemorrhages, 3 per cent; perforation, 8 per cent; stenosis with vomiting and loss of weight, 8 per cent; intractable pain, a penetrating ulcer, neurotic conditions, or simply the advice of the family physician accounted for the remaining 73 per cent. In other words an absolute indication was present in only 38 per cent of the entire material.

The onset of the disease was most frequent in the third decade of life. The average period between the onset and the operation was 11 years in men and 10 years in women.

Of the 632 patients who appeared for a re-examination, 314 had no complaints. Sixty-six per cent of those who registered some complaints had disturbances of the function of the small intestines, 32 per cent had gastritis of the remaining stump of the stomach, 32 per cent had symptoms of the "little stomach," 26 per cent had hypersensitiveness to milk, and 20 per cent had biliary belching. Disturbances of fat digestion and anemia accounted for only 8 per cent. It is possible that a diet rich in carbohydrate and poor in fat and proteins was responsible for the great frequency of jejunitis.

Approximately 20 per cent of the entire material showed improvement 3 years after the operation, 37 per cent of the patients were cured and 43 per cent were not benefited. The percentage of cures was higher in the group with gastric ulcer than in that with duodenal ulcer.

# SURGERY OF THE ABDOMEN

After the operation the majority of patients drifted toward professions not requiring physical effort. Only very few regained the weight that they had lost before the operation.

JOSEPH K. NARAT M D

**Pyloric Stenosis Caused by the Ingestion of Corrosive Substances: Report of a Case.** HOWARD A. GRAY and CHESTER L. HOLMES. *Surg. Clin. N. America* 1948, 28 1047

The authors article is based on the report of a case in which pyloric stenosis developed about a month after the ingestion of 1 5 ounces (45 c.c.) of sulfuric acid. A review of the literature has disclosed reports of 139 other cases in which pyloric stenosis has followed the ingestion of a corrosive substance.

The ingestion of caustic alkalies injures the esophagus and frequently causes cicatricial stenosis of this organ. Although corrosive alkalies are usually quickly neutralized after they enter the stomach gastric or pyloric stenosis occurs in about 20 per cent of the cases in which these corrosives are ingested.

The effect of ingested acids is noted generally as a pyloric or antral stenosis. This usually causes symptoms in about 4 to 6 weeks, although the literature contains reports of several cases in which there was no evidence of pyloric obstruction until 5 or 6 years after the ingestion of an acid. Approximately 20 per cent of patients with pyloric stenosis due to ingestion of a corrosive acid also will have an esophageal stricture.

In most cases the diagnosis will be simple if the physician is aware of this propensity of acids to inflict the major damage on the pylorus. It may be impossible for the roentgenologist to distinguish the stenosis of corrosive origin from carcinoma of the stomach if the request for roentgenologic examination is not accompanied by the case history.

In the early surgical treatment a jejunostomy may be indicated to assist in the restoration of fluid and electrolyte balance, and to maintain nutrition until inflammation in the stomach and esophagus subsides. In this manner time will be gained and the patient can be observed in order to determine if severe stenosis is going to develop. The general condition of the patient and the local condition of the tissues may permit more extensive operative procedures if a conservative course is followed in the early stages of the disease. Of the three procedures most frequently used partial gastrectomy would seem to offer the most satisfactory results.

**Acute Pseudomembranous Enteritis or Enterocolitis. A Complication Following Intestinal Surgery.** CLAUDE F. DIXON and ROGER E. WEISSMAN. *Surg. Clin. N. America*, 1948, 28, 999.

Acute pseudomembranous inflammation involving the mucosa and submucosa of the gastrointestinal tract has been studied by pathologists in connection with severe infectious diseases, serious poisoning and severe constitutional disorders. Except in the acute severe diarrheal maladies or in dysentery the clinical manifestations of the condition have not

been thoroughly understood. Pathologists also often have been unable to ascribe clinical importance to pseudomembranous lesions of the digestive tract found at autopsy.

Such lesions apparently follow surgical procedures sufficiently often to be of importance. Surgeons have become increasingly aware of this disorder in the study of postoperative mortality. There is however insufficient information available regarding incidence etiology pathogenesis clinical manifestations and treatment. This lack of information has prompted the authors to carry out this study.

At the Mayo Clinic acute pseudomembranous ileocolitis has been encountered at autopsy in cases in which a wide variety of both medical and surgical conditions have existed. In many cases these inflammatory intestinal lesions were an important, or the sole cause of death. The lesions have been observed at postmortem examination in cases in which death had followed operations on the brain spinal column breast gall bladder uterus stomach or other organs. They also have occurred from a variety of causes in nonsurgical cases.

The authors interest was stimulated by the recovery, under treatment of 2 patients who following radical resection of the colon presumably had mild or moderate acute postoperative pseudomembranous ileocolitis. These cases are included in their series of 23. Twenty more cases of the 23 were so cured when they reviewed clinical records of a period of 7 5 years. Their survey included records of all cases in which the patients died following operation on the small or large intestine or the rectum and in which the pathologists discovered significant pseudomembranous lesions of the mucous membrane of the stomach or of the small or large intestine. Finally in 1 case of the 23 permission for autopsy was not obtained but the clinical manifestations strongly suggested that the patient died of acute pseudomembranous enterocolitis. Several of the patients including the 2 mentioned who did not die were observed by one or both of the authors.

The frequency with which the lesions occur cannot be determined in this study but it appears that pseudomembranous lesions were more frequently encountered in the last 18 months than earlier in the period of study. The reason is not apparent and the increase occurred in spite of use of sulfonamides in preoperative preparation for intestinal surgery.

There were 13 males and 10 females in the series. The oldest patient was 76 years old and the youngest 2 days old. Seventeen of the 23 patients were more than 40 years of age. This incidence may be expected however because of the greater number of older persons who require major intestinal surgery.

The lesions often involved the small bowel terminal jejunum only or most of the small bowel terminating sharply at the ileocecal junction. Intrinsic factors of mechanical or circulatory nature seem to be important. In more typical varieties of the series

lesions were present largely in the ileum and superior portion of the colon.

Acute, subacute and chronic infarctions usually result in degeneration and necrosis of the entire bowel wall the extent depending on the degree of ischemia. Congestion of the intestine as a result of congestive heart failure, chronic pulmonary disease or portal hypertension was noted by Bockus as an important predisposing factor of many inflammatory changes.

Successful management demands that the condition be recognized at once. From the above experience certain manifestations strongly suggest the presence of pseudomembranous enterocolitis. Acute cramping diffuse abdominal pain with or without diarrhea or frequent or constant discharge from a colonic tooma may be the earliest signs. In many cases, however, severe circulatory collapse usually unexplained may precede the onset of external intestinal involvement; this is particularly important if an unlikely state of shock is resistant to antishock measures. The abdomen is usually mildly to moderately distended; tenderness is diffuse nonlocalizing and mild. Vomiting may be present. Although of little value from the standpoint of early diagnosis, later in the course the fecal contents become extremely foul serous or seropurulent and may contain identifiable pseudomembrane.

Differential diagnosis of this condition from the more common postoperative complications in the abdomen is extremely difficult.

In spite of the fatal outcome in most cases of their series, in which ten cases of pseudomembranous enterocolitis existed either alone or in combination with serious intra-abdominal disturbances, the authors believe that the prognosis is not uniformly hopeless. Heroic effect are needed though, if many of the patients are to survive.

Definitive treatment of pseudomembranous enterocolitis must be largely on empiric grounds until basic etiologic and pathogenic factors are understood. Of primary importance are realization of the possibility of presence of the entity, prompt recognition of related symptoms and during the ensuing hours of antishock treatment an attempt to make tentative or a working diagnosis.

Aggressive and prompt replacement of fluids preferably in the form of whole blood and plasma must follow recognition of the downhill course.

In the presence of marked circulatory collapse or rapidly developing tissue ischemia administration of oxygen by inhalation would be an important adjunct to other supportive treatment.

Antibiotics preferably penicillin in doses up to 100,000 Oxford units every 3 hours should be instituted to assist the intestinal wall in combating secondary invasion by certain pathogenic microorganisms which appears feasible when sufficient damage to the mucosa and submucosa has taken place. Streptomycin has not to the authors knowledge been used with success in the treatment of this condition.

If fecal discharges are excessive, some good effect may be obtained from codeine, pantopon, dilaudid or morphine in combating peristalsis.

The question of the value of poorly absorbed or nonabsorbable sulfonamides, orally or by gastrointestinal tube could not be ascertained.

Laparotomy in the presence of acute pseudomembranous enteritis, is contraindicated unless other intra-abdominal lesions necessitate such surgical treatment. In some instances the presence of a severe process such as perforation of a viscus, leakage at an anastomosis or strangulating obstruction may be so strongly suggested that no other course is open. Operation on the bowel itself may be hazardous because the pseudomembranous lesions of the mucosa are of any great extent.

Of the 30 cases in which autopsy revealed the presence of severe gastric or intestinal pseudomembranous lesions of the mucosa, reports of 4 are given in some detail. These cases are considered typical of those in which the pathologist considered the pseudomembranous inflammatory lesions to be one of the most important contributing causes of death. The entire series is summarized within the article.

Duodenitis (Le duodenitis). A. TAVERNIER, *Arch. Mal. Mal. pp. digest* 943, 4:387.

An extensive study of the anatomy and histology of the duodenum led the author to the conclusion that pure isolated, circumscribed duodenitis is a rare condition because usually the inflammatory process involves also the adjoining portions of the stomach. Therefore, the term "gastroduodenitis" or "duodenopyloroenteritis" is a more appropriate term.

Heterotopia, such as the presence of islands of gastric mucosa in the duodenum, and vice versa, is of great importance for the pathologic anatomy of this region and must be considered in the pathogenesis of ulcerative processes. In the strict sense of the word the nosologic or pathologic entity of duodenitis is not acceptable. Numerous lymphatic communications exist between the duodenum and the stomach. Close connections can be demonstrated also between the lymphatic system of the appendix on the one hand and the duodenopancreatic region on the other. From the purely anatomical point of view no clear border can be established between the stomach and the duodenum. It follows that the duodenum alone cannot be made responsible for the pathogenesis of inflammatory processes originating in that region. As a rule, alterations may be found in the adjoining organs such as the liver or pancreas.

Duodenitis may follow cholangitis, cholecystitis, pancreatitis, or appendicitis.

Acute and chronic varieties of duodenitis may be distinguished.

JOSEPH M. VABAT, M.D.

J. Juncosac Insufficiency: Its Relation to the Sprue Syndrome. E. LEONARD PERRY, JR. and J. ARNOLD BARNES, *Surg. Clin. N. America*, 943, 28:903.

The pathologic condition which has been recognized as a deficiency state akin to or representative



of the sprue syndrome is due to various causes. In some of the reported cases of the sprue syndrome in which the patients have had symptoms of a deficiency state exploratory laparotomy or autopsy has disclosed an unsuspected disease of the small intestine or has revealed that a variable portion of the small intestine had been isolated previously by a short-circuiting procedure.

The authors wish to re-emphasize that sprue is a syndrome which may have a diverse origin.

It becomes obvious that (1) an intact wall of the small intestine (2) a normally functioning mucosa, (3) normal peristalsis and normal transportation of the chyme (4) the presence of adequate digestive enzymes and bile and (5) intact lymphatics are essential for adequate digestion and absorption. A break in any of these may eventuate in a deficiency state. Impairment of the absorptive ability of the small intestine is almost universally incriminated as the underlying cause of jejunoileac insufficiency.

Experiments on animals have demonstrated that the immediate effects of massive resection of the intestine are hunger, thirst, loss of weight, and diarrhea. As much as 66 per cent of ingested foodstuffs may be lost in the feces. Compensation occurs gradually. If the animals are fed a rich, easily assimilable diet digestion becomes normal. The animals are able to absorb all foodstuffs and there is a considerable increase in the absorption of carbohydrates. The animals appear normal but they are very sensitive to unfavorable dietary and environmental conditions.

The compensatory process is characterized by hypertrophy and hyperplasia of the remaining portion of the intestine proximal to the site of the resection. Neither the stomach nor the portion of the intestine distal to the site of the resection undergoes any change. The diameter of the portion of the intestine involved in the compensatory process increases and may become twice as large as normal. There also is an increase of as much as 400 per cent in the absorptive surface of the involved portion of the intestine. It appears likely that this increase in the absorptive surface approaches the epithelial area of the excised portion of the intestine. This compensatory process also has been observed in human beings who have undergone massive resection of the intestine.

The amount of human intestine that can be resected without causing serious sequelae or death varies greatly in different cases. Resection of the small intestine of human beings is followed by many sequelae. Diarrhea is the most frequent one. It is associated with an excessive loss of fat, protein and electrolytes in the feces. This abnormality may be so severe and intractable as to interfere greatly with bodily nutrition and it even may cause death. The diarrhea is aggravated by the inclusion of an excessive amount of fat in the diet. Anemia of various types, loss of weight, edema, tetany and pernicious vomiting are other sequelae that may occur. There also may be a decrease in the concentration of calcium and protein in the serum.

After resection of the small intestine the physical condition of the patient appears to depend on the following factors: (1) the pathologic conditions which necessitated the resection, (2) the length and physical condition of the remaining portion of the intestine and the extent to which it is able to compensate for the resection, (3) the resistance of the patient, and (4) the type of dietary regimen that is instituted after the operation.

This article is based on a study of a large number of patients with jejunoileac insufficiency and includes a report of 6 illustrative cases.

#### The Surgical Treatment of Congenital Megacolon.

CLAUDE F. DIXON and DAVID B. JUDD. *Surg. Clin. N. America* 1948, 28: 889.

Congenital megacolon or Hirschsprung's disease ensues from an imbalance in the nervous mechanism which controls the function of the bowel. As a result the bowel tends to dilate more readily than to contract. This imbalance in turn, may be due to a deficiency of ganglia and fibers in Auerbach's plexus. As a result of prolonged and marked dilatation the bowel becomes elongated and its walls hypertrophied. Attempts to overcome the imbalance by drug therapy and other medical measures have met with variable and incomplete success.

Resection of the lumbar sympathetic ganglia and nerves is a surgical means of attacking the problem from the same angle, and it too has achieved uncertain results. Many authors have expressed satisfaction with this method of treatment but the experience of the authors has not been encouraging. Of 26 patients in whom sympathectomy was performed only 1 appeared to have a satisfactory result. Aside from this there remains the fact that sympathectomy does not remove the pathologic condition present, and it appears that the danger of disaster such as from obstruction, volvulus or perforation of the diseased segment of bowel is not lessened by sympathectomy.

On the other hand the authors' experience with resection of the diseased bowel has been most encouraging. Of all the patients in whom resection was performed 78 per cent were benefited and 67 per cent were completely relieved of their symptoms. If only the traced patients are considered, 93 per cent were benefited and 84 per cent were completely relieved. The two main reasons that resection has not been in greater favor as the treatment of choice for congenital megacolon are (1) a high primary mortality rate and (2) fear of recurrence in the portion of colon not removed. It is the authors' belief that the mortality rate during hospitalization need not be high following this procedure. With proper co-operation between pediatrician, internist, and surgeon all facilities for preoperative preparation of the patient can be utilized to the fullest extent and the risk of the operation can be reduced accordingly. In their most recent series of cases the mortality rate during hospitalization was 4 per cent, and they believe that the rate will be even lower in the future.

Resection should not be performed in children under 5 years of age unless it is absolutely necessary since they do not tolerate resection of the bowel well. The postoperative mortality rate in this age group was nearly 45 per cent. In the majority of such cases the symptoms can be controlled reasonably well for a time by medical measures, including diet, laxatives, enemas, and drugs such as mechohyl; therefore, these young children should be carried along on the regimen until they are 5 years of age or older. However it is not advisable to prolong the regimen in the presence of persistent and severe symptoms such as constipation, abdominal distention, nausea, and vomiting.

Frequently by the time the child is of school age it becomes apparent that he is not like normal youngsters and the parent as well as the patients want something done to achieve more early complete relief from the symptoms, particularly the symptom of abdominal distention which when marked often cause the distal margins to flare out. Also it appears that if the symptoms are not well controlled by medical measures the danger of ultimate disaster is great. Few more effective measures are employed.

The fear that the disease will recur in the remaining portion of bowel after partial colectomy is not substantiated by the authors' experience with this procedure. In the group of 54 cases in which resection was performed, there were 4 in which half or less than half of the colon was removed and in case was the evidence of recurrence of the disease in the remaining portion of the colon. In 5 of these 41 cases there was complete relief from symptoms.

For these reasons the authors believe that cases of congenital megacolon the treatment of choice is resection of the diseased segment of bowel. If the patient is 5 years of age or younger surgical treatment should be delayed and the symptoms should be controlled as much as possible by medical measures until the child becomes older. It is the authors' belief, however, that in the majority of cases resection of the diseased bowel will be necessary before complete relief from symptoms is obtained.

**Hemorrhoids and Cancer** NELS CARSTEN. *Acta Chir. Scand.*, 94B, 97-7

Hemorrhoids are an enlarged and varicose condition of the hemorrhoidal veins, and may be external when they arise from the inferior hemorrhoidal veins and drain into the caecal system and internal when they arise from the superior hemorrhoidal veins and drain into the portal system. They may be coexistent and merge into one another. External hemorrhoids are relatively less serious and less important, although they may in some complications such as infections and anal hematomas, which are frequently painful. Bleeding is not so frequent in this type of hemorrhoids.

Internal hemorrhoids are more serious because of pain and discomfort, and are more important because their recognition is valuable in the differential diagnosis of other rectal lesions.

**TABLE I.—HEMORRHOIDS AND CANCER INDICATIONS FOR ROENTGENOLOGIC EXAMINATION IN 164 CASES OF CANCER OF THE COLON**

	PO	SM	MLP	RLS	RLS	SPH	Total
I Hemorrhoids without other symptoms (Routine examinations)							
II Suspicion of internal general symptoms, relation to sigmoid bleeding in a partial symptom	6		5		6		
III Suspicion of tumor, obstruction, palpable abdominal tumor etc. with no bleeding	6	9	18		8	1	77
IV No symptoms of colon, intestinal obstruction	3	14			3		37
V Palpable tumor per rectum							6
VI Remains unclassified							24

The not infrequent association of cancer with internal hemorrhoids is emphasized by the author. The fact that from 10 to 50 per cent of the patients admitted at a large clinic for rectal cancer had undergone previous hemorrhoidectomy is mentioned. Since 1940 not only a thorough palpation of the rectum but also a roentgenologic examination of all cases of hemorrhoids in patients over 40 years of age has been the rule at the Surgical Clinic of Lund. This report considers the patients so examined from 1940 to 1946 inclusive, and the author endeavored to determine the frequency and correlation between hemorrhoids and cancer of the colon and rectum. Patients with cancer of the colon and rectum were examined both by palpation and proctoscopy to ascertain the presence or absence of hemorrhoids and similar examination was made on control material.

Table I demonstrates that, at the Lund Clinic, the routine roentgenologic examination of patients with hemorrhoids but without other symptoms has not led to the discovery of cancer of the colon.

Table II tends to show that hemorrhoids are probably not more common in patients with colonic or rectal cancer than in otherwise healthy people.

The author concludes that if anoscopy of a patient free of symptoms of a tumor permits a clear diagnosis of hemorrhoids, and palpation and sigmoidoscopy permit one to establish the absence of cancer in the

**TABLE II.—HEMORRHOIDS AND CANCER**

	No. of cases	Occurrence of hemorrhoids	
		No.	Per cent
Cancer material	51		31
colonic	29	3	45
rectal		6	97
Control material	104	42	4

rectum and rectosigmoid the necessity of a roentgenographic examination may be questioned

ERNEST D. BLOOMENTAL, M.D.

**Anterior Resection for Malignant Lesions of the Upper Part of the Rectum and Lower Part of the Sigmoid.** CLAUDE K. DIXON, *Ann Surg* 1948, 128: 475.

The operation of anterior resection for lesions of the terminal part of the large intestine with re-establishment of intestinal continuity has been criticized by many authors as not being sufficiently radical. The complete article is an evaluation of the operation. The efficacy of any surgical procedure for cancer is judged by the number of persons undergoing the procedure who are alive 5 years or more and not on an anatomic basis—the extent of the excision.

This study is limited to the most controversial segment of the large intestine namely the distal 20 cm. It is for this region that new procedures are constantly being advocated and interest in old ones is being rekindled. A matter of 3 or 4 cm. from the dentate line makes the difference between an operation involving a permanent colonic stoma and one in which intestinal continuity can be re-established. While the majority of patients become adjusted to a permanent colonic stoma there are some who have difficulty in its management. Those cured by anterior resection can live normally in every respect.

Anterior resection for removal of carcinomas of the upper part of the rectum and lower part of the sigmoid was performed in 426 cases at the Mayo Clinic from 1930 through 1947. While there is a slight predominance of males in the series the female patients tend to be younger and their lesions tend to be of a higher grade and closer to the dentate line. There were 25 deaths among the 426 cases a mortality rate of 5.9 per cent. Following 270 resections since the present method of preoperative and postoperative management has been used there were 7 deaths (2.6 per cent). Of 272 patients the 5 year survival rate was 67.7 per cent.

Comparisons of the mortality and survival rates according to the location of the lesions in various segments of the bowel revealed that the operation is sufficiently safe and radical for lesions of the upper half of the rectum. In cases of adenocarcinoma of the mucous (colloid) and papillary types the prognosis is poorer. The signal improvement in the operative mortality rate in colonic surgery in the past 10 years has not been as marked for lesions in the rectum as for those immediately above that region. Whereas 10 years ago operations for rectal lesions were safest this no longer is true. The survival rate after resection of low rectal lesions is poorer than that following resection of lesions higher in the bowel and greater difficulty in resecting the region of spread. The lesions covered by this study are considered in terms of their distance from the dentate line because of this consideration and because this distance determines preservation of the sphincter.

**Experiences with Operation for Rectal Carcinoma with Preservation of the Sphincter (Unsere Erfahrungen bei der Operation des Rectumcarcinoms mit Sphinktererhaltung)** A. BRUNNER, *Helvet chirurg* 1948, 15: 375.

The author reports on 9 cases of operation for carcinoma of the rectum with preservation of the sphincter in which he followed the pull through procedures of Kirschner and Bacon. If the tumor is not too large and is freely movable the procedure may be carried out provided the lower limit of the tumor is from 5 to 6 cm. above the anus. In the 9 reported cases the lower limit of the tumor was from 6 to 7 cm. (5 cases) and from 9 to 14 cm. (4 cases) above the anus. Therefore up to 30 cm. of intestine could be extirpated. The preservation of the sphincter muscle carries with it the danger of strangulation of the pulled through intestine because of postoperative swelling of the tissues.

One of the author's coworkers had 1 case of necrosis of the lower intestinal segment followed by a fatal ascending infection of the pelvic connective tissue. A second patient was lost as a result of massive pulmonary embolism 3 weeks after operation. In the other cases the blood supply of the pulled through intestine remained good.

A certain degree of stretching of the sphincter muscle cannot be avoided but this is never so severe that recovery of muscle function does not occur within the course of a few weeks. Sphincter closure begins in a short time but under some circumstances satisfactory continence is not achieved for a few months. In the early period thin stools cannot be retained and the patients are annoyed by an increase in bowel movements. In 1 patient a definite stricture developed which required dilatation for months. In the 6 other patients the local condition of the anus was very satisfactory. Since no mucosal prolapse developed these patients had no complaint of moisture. The sphincter admitted the passage of one finger easily. Active closure was very good. Several months after operation gas could be retained.

JOHN L. LINQUIST, M.D.

## LIVER, GALL BLADDER, PANCREAS, AND SPLEEN

**Hepatic Coma.** T. LYNN MURPHY, THOMAS C. CHALMERS, RICHARD D. ECKHARDT and CHARLES S. DAVIDSON, *V. England J. M.* 1948, 239: 605.

Hepatic coma is a distinct clinical syndrome occurring in patients suffering with acute or chronic, severe liver disease, and characterized by lethargy progressing to noisy confusion coma and usually to death. The state has inaptly been termed cholemic acidosis in the blood as being the etiologic factor is now generally discredited. The syndrome may occur without evident cause in patients suffering severe liver disease, or may be precipitated in such cases by (1) infection such as pneumonia or peritonitis (2) acute hemorrhage as from esophageal varices or by

(3) the injudicious use of sedatives such as morphine, the barbiturates, or paraldehyde.

In an attempt to elucidate the underlying pathologic physiology of the condition the authors studied 40 patients who died in coma and who clinically and pathologically had severe primary liver disease. Twenty cases of uncomplicated coma in which no other cause for death than liver disease was found and 20 complicated cases in which the patient had some major complication such as hemorrhage, peritonitis, tuberculosis, or pneumonia in addition to marked liver disease were selected for consideration. In all cases the neurologic findings were inconstant. Laboratory estimates were made of the blood non protein nitrogen, carbon dioxide combining power, blood sugar, serum bilirubin, blood prothrombin content, thymol turbidity and cephalin flocculation; none of these were distinct other than of severe liver damage and did not significantly differ in the comatose state from the precoma findings.

Treatment is directed at the maintenance of nutrition, control of hemorrhage or infection, and avoidance of sedatives, but is in general unsatisfactory. Analeptics such as glucose, sodium succinate, caffeine or benzedrine are without effect on the comatose state.

WALTER ELLIS CAMPBELL, M.D.

**The Operative Treatment of Gallstone Disease in the Light of Ultimate Results (Die operative Behandlung des Gallensteinleidens im Dauererfolg)**  
VICTOR HOFFMANN, *Chirurg* 94:5, 9 1937

In the year 1904 the author sent questionnaires to 14 patients whom he had operated upon for gallstones from 8 to 20 years previously. The material comprised 79 cases of which only 3 could not be located. From the replies returned by the operative patients he was able to deduce statistically with considerable exactness (they were all operated on by himself either as chief surgeon or as assistant) the result obtained.

From the data received it is concluded that the operation for gallstones (cholecystectomy and in some cases cholecystotomy with drainage) resulted in complete relief from the bile passage symptoms in 64 per cent of the cases. However, when the cases with a single or with a few attacks following the operation, and those relieved by a second operation are included, as well as those with dyspeptic symptoms but without true gallstone colic, the percentage of success rises to 90. In 8 per cent of the patients the pains were either not relieved or they recurred later but they were not so severe as in the original attacks and were unattended by jaundice. Not all of these attacks of pain were colicky in character. Only in 3.1 per cent were the attacks of pain at all characteristic and accompanied by jaundice. Of these patients, 5 were reoperated upon and in 3 a stone was found in the choledochus. In 1 of these the stone had been overlooked at the first operation and in 2 another stone had apparently formed. In the remaining 3 a stone was not found at reoperation, but the choledochus was dilated with infection in 2

patient. A choledochoduodenostomy at reoperation brought complete and enduring relief.

In this material during this period, there were 20 deaths however none of these deaths could be imputed to the operation or to the continuance of the gallstone disease after operation.

The author emphasizes the fact that these patients could by no means be considered as having been operated upon early. He thus believes that the operation of cholecystectomy is effective in gallstone disease, that the mortality of the operation and the importance of recurrences attributable to the disease following the operation have been grossly exaggerated, and that the efforts of the surgeon should be expended in bringing these patients to operation as early as possible if possible before the stone invades the choledochus. The author recommends cholecystectomy as soon as the roentgenologic examination discloses the presence of stones in the gall bladder no matter how small they are, and considers the operation a pressing one as soon as any indication arises of the presence of an accompanying pancreatitis. The presence of pancreatitis must in these cases be sought with greater diligence than has heretofore been customary.

JOHN W. BRYNAN, M.D.

**The Pancreatic Fistulas and Their Treatment.**  
MICHAEL P. BASKIN, *Helleniki Iatriki* 1947 6 909.

The author described in detail the case of a pancreatic fistula after manipulation of a pancreatic cyst. He succeeded in curing the fistula by implanting it into the posterior wall of the stomach. The patient was completely cured 15 years after the operation.

This case the first of this condition in which surgery was used in Greece led the author to study the international references to all similar cases reported up to this time amounting to 42. He describes the details of the operative technique and recommends that the implantation be made preferably in the stomach in the cases of fistulas occurring above the anterior curvature of the stomach, while the implantation should be made in the posterior wall of the stomach when the fistulas are in the gastrocolic ligament.

If a resection of the stomach was done previously the implantation may be made on the excluded jejunum, the duodenal stump or the gall bladder. The immediate results of the operation are exceptionally satisfactory. The only failures among these 42 operations were 2 deaths and 1 relapse. The remote results are not known except in only a few cases. However in 10 cases reported in the literature the patients were well from 1 to 10 years after operation.

In contrast to the excellent results of the operative treatment, the results of the various conservative treatments proposed up to now are of doubtful efficiency and for this reason the author recommends that when 3 months of conservative treatment fails or proves unsatisfactory operation should be done.

# GYNECOLOGY

## UTERUS

Age, Incidence and Distribution of 4 652 Cases of Carcinoma of the Cervix. MARVIN G. SADDOR and JAMES P. PALMER. *Am J Obst* 1948, 56 680.

An age study was made of 4 652 patients with carcinoma of the cervix who were admitted to the Roswell Park Memorial Institute Buffalo New York, during the period from 1914 to 1946 inclusive. The age of the youngest patient was 18 years and that of the oldest 84 years. Three cases of proved carcinoma of the cervix were found in women under 30 years of age. A detailed study is presented of these 3 cases. It is important that the physician realize that malignancy of the cervix may occur at any age period after the first decade of life and the possibility of the presence of carcinoma of the cervix should not be eliminated solely because of the age of the patient.

Although the majority of carcinomas were found in patients in the 40's 75 per cent were noted in those under 40. A similar percentage also was found in those over 70 years of age.

JOHN R. WOLFF M.D.

The Ovary in Endometrial Carcinoma. EYRAIM WOLF, ARTHUR T. HEART, GEORGE VAN S. SMITH, and LEWIS C. JOHNSON. *Am J Obst* 1948, 56 617.

Previous studies of the ovary in cases of endometrial carcinoma made by the authors showed that there was a stromal hyperplasia of the ovaries. To confirm the significance of this stromal hyperplasia a study of the stroma of the normal ovary was undertaken. These findings were then compared with the stromal changes in 331 cases of carcinoma of the endometrium.

The ovarian stroma differentiates into the cells of the granulosa theca interna corpus luteum and corpus albicans. This process normally follows an orderly sequence which possibly is regulated by the ovum.

In senility this differentiation recapitulates the normal sequences but in disorderly manner leading to stromal hyperplasia thecomatous cortical granuloma formation and granulosa and theca cell tumors.

Stromal hyperplasia makes its appearance in the fourth and fifth decades reaches its height in the sixth decade and thereafter tends to subside with old age. This stromal hyperplasia is significantly more frequent in cases of endometrial carcinoma (from 56% to 92%) than in a controlled group (from 36% to 43%) and persists into advanced old age. The thecoma is significantly more common in endometrial cancer than in the control series (9 to 1). Sebaceous corpora lutea and theca lutein cysts are also more common in the cancer cases.

The existence of hormonal factors in endometrial carcinoma is discussed. JOHN R. WOLFF M.D.

## ADNEXAL AND PERIUTERINE CONDITIONS

Torsion of the Hydatid of Morgagni. RALPH A. REIS and EDWIN J. DE COSTA. *Am J Obst* 1948, 56 770.

The hydatid of Morgagni is usually thought to be an innocent structure. Yet during the past 10 years at the Michael Reese Hospital Chicago Illinois Reis and DeCosta have operated on 5 patients whose symptoms were due to torsion of this structure. Although a review of the world literature reveals only 21 references to this clinical syndrome the authors believe that this condition probably occurs fairly frequently. At times it may be overlooked at other undiagnosed.

Since torsion and even gangrene can occur with few if any complaints the pelvic organs should be examined at every laparotomy. This is important when serousanguinous fluid is encountered.

The clinical symptoms of torsion simulate those of appendicitis with colicky intermittent abdominal pain. Nausea and vomiting are frequently present. The temperature usually is less than 101 degrees and the pulse under 96. Examination gives the impression of appendicitis either on the right or left side. Bimanual findings are not helpful.

Torsion even when associated with gangrene does not always lead to serious intra abdominal disease. Aseptic necrosis with only slight peritoneal reaction and complete recovery may occur.

Pedunculated hydatids of Morgagni encountered during surgical procedures should be removed prophylactically. JOHN R. WOLFF M.D.

Hemoperitoneum of Ovarian Origin (Emoperitoneo de origine ovarica). RICCARDO MONTANELLI. *Riv ostet gine* 1947 2 338.

Two women one 37 years of age and the other 34 years of age were admitted to the hospital a few hours after coitus with symptoms of peritoneal hemorrhage. Both presented extreme anemia and puncture through the vaginal fornix brought to light fresh blood in the pouch of Douglas. Both were diagnosed as presenting tubal abortion and they were immediately laparotomized. In each case the source of the bleeding was found to be a ruptured corpus luteum cyst of the ovary. The older patient had 4 living children and there was also a corpus luteum cyst in the nonruptured ovary so that it was thought advisable to remove both ovaries in the younger patient the other ovary was normal in appearance and was left in situ.

Histological examination disclosed in addition to the usual picture of a ruptured corpus luteum cyst, extensive extravasation of blood throughout the remainder of the ovary (ovarian apoplexy) a dilatation and an increase in the number of the blood vessels about the cyst especially in the area of its base and a great number of developing ovarian

follicles. This appearance of tumefactive follicular development is suggested to be the result of a hyperplasticism, and to this hormonal disturbance is ascribed also the angiomatoid vascular development and the tendency toward ovarian apoplexy. The coitus was regarded in each instance as merely the exciting cause.

In these 2 cases the diagnosis of tubal abortion was made solely on the sudden attack of anemia and the results of the vaginal puncture but, of course these findings do not tell anything about the point of origin of the bleeding. The author does not believe that the distinction between ruptured extruterine pregnancy and ruptured corpus luteum cyst can always be made however in these 2 cases of hemoperitoneum in nonpregnant women, an attentive search should have been made for other signs of pregnancy. Thus, he believes that a more nearly exact diagnosis could be achieved in many of these cases, and while it might not radically alter the therapeutic procedure, it would at least gain more insight into the manner of distinguishing the two conditions and would permit of a more enlightened planning of the therapy to be pursued.

JOHN W. BRENNER, M.D.

**Brenner Tumors with a Predominance of Muciparous and Granulosa-like Elements (Tumore di Brenner con prevalenza di elementi mucipari granulosa-like) L. GAGLIARDI, *Riv. Ital. Ginec.*, 1935, 3: 37.**

The tumor studied by the author for histologic interpretation was one of bilateral growth removed by subtotal hysterectomy and bilateral salpingo-oophorectomy from a 39 year old woman who had borne one living child and who was menstruating normally without evidence of abnormality in other organs of masculinization, or of abnormal appearances in the endometrium. The two masses presented much the same macroscopic appearance, but the tumor making up the right ovary was smaller than that on the left side and was roughly reniform and mammillated. The tumor involving the left ovary on the other hand, was rounded and on cross section exhibited two rather large cystlike formations.

Sections from various areas of this large rounded tumor mass presented the usual histologic findings of a typical Brenner's tumor namely, a fibroepithelioma, the epithelial elements of which were composed of paramesonephric epithelium pseudomucinous and serous epithelium (in many places cystic and vacuolized) and a number of other findings which have not so far been described for the Brenner tumor and which make them worthy of publication at this time.

One of these odd findings was extensive areas of young connective tissue as a rule surrounding the more immature types of Brenner-cell formations, which strongly resembled the cells of the granulosa-cell tumors, but were evidently not of that origin and were ascribed by the author to have an origin in common with the ovarian teratoma. Another odd finding was that of muciparous cells in rosette arrange-

ments about small central vacuoles and the presence of muciparous elements with nuclei pushed to the periphery which were seen scattered about among the connective tissue elements and closely associated with them. These are the findings in the so-called solid pseudomuciparous adenoma of the ovary and their appearance in the Brenner tumor affords a new proof of the close relationship between Brenner's tumor and the pseudomucinous tumors.

On the whole, the author ascribes the origin of these tumors to a heterotopic implant in the ovary of the same nature as that from which teratoma of the ovary arises.

JOHN W. BRENNER, M.D.

## EXTERNAL GENITALIA

**Gynastresia: Three Uncommon Clinical Types. R. O. MALPHEANT, *Brit. M. J.*, 1945, 7: 555.**

Anomalies due to aplasia of the female genital tract are not infrequent and all varieties and degrees of gynastresia may result. The more complex congenital abnormalities are usually associated with a nonfunctioning uterus and are rarely of much practical importance.

The author describes three unusual types of gynastresia, with certain features in common. Failure of canalization was limited in extent and localized to the cervical or vaginal segments of the müllerian tract and the symptomatology was dependent upon the presence of a functioning uterus. In 2 cases, hematometra was observed as the result of atresia at the level of the cervix. In the third case a hydrocolpos was found—a condition in which an accumulation of watery or mucous fluid in the vagina may produce serious mechanical effects during infancy and childhood.

The first case was one of congenital atresia of the cervix with hematometra. Usually hematometra is caused by occlusion of the lower end of the vagina, and it then occurs as a secondary (though important) complication of hematocolpos. Stagnation of blood in the uterine cavity due to obstruction at the cervical level, is usually an acquired condition and develops as a result of scarring following operation or childbirth. Hematometra due to strictures of obstetric origin generally occurs after difficult confinements associated with infection and much excoriation. Postoperative hematometra has usually been reported after plastic operations on the cervix, but has also occurred following the use of radium for benign uterine hemorrhage. In many cases of acquired stricture the stenosis is incomplete and, while blood accumulates within the uterus, there is some leakage past the obstruction.

Congenital occlusion of the cervix is a condition of great rarity and few examples have been recorded in the literature. Cervical aplasia is usually associated with more complex developmental anomalies of the genital tract, and the uterus then is rarely developed enough to perform the function of menstruation.

A case of hematometra in an atresic horn of a bicornate uterus in a girl aged 13 is also reported.

She was admitted because of severe dysmenorrhea. Her menses had started 9 months previously and were regular and lasted 7 days every 28 days. The menstrual pain was localized mainly to the left iliac fossa.

Three types of gynaesthesia are described. Distinctive clinical features were observed in each type and all were amenable to conservative treatment. Developmental anomalies of this order though rare are of much practical interest, for unless recognized patients may be submitted to needlessly radical operative procedures.

HARRY W. FINK, M.D.

**Cleavage Planes in Reconstructive Vaginal Plastic Surgery.** J. V. RICCI, C. H. THOM and W. L. ARON.  
*Am. J. Surg.* 1948, 76: 354.

The vagina as a point *d'appui* is directly involved in surgery for relaxations, lacerations, fistulous formations, and the descent of the urethrovaginal and rectovaginal parts.

These basic relationships are clear. There is a complete fusion between the anterior vaginal wall and that of the urethra throughout its entire length. Because of this fusion, surgical separation of these two structures can be accomplished only by blunt dissection, and this leads to an unavoidable oozing. There is a clear-cut line of separation, an areolar cleavage plane between the anterior vaginal wall and the juxtaposed bladder wall from the urethrovaginal area to the point of fusion of the vagina and the cervix. This areolar cleavage plane extends beyond this point and separates the bladder wall from the cervicofundal surface up to the vesicouterine peritoneal reflection. These definite lines of separation or areolar cleavage planes lead to a bloodless separation of the bladder from the vaginal wall and from the cervicofundal surface. There is a complete fusion of the posterior vaginal wall with the short perineo-anal body. Separation of these structures, which can be accomplished only by blunt dissection, leads to an unavoidable oozing. There is a clear-cut line of separation, an areolar cleavage plane between the posterior wall of the vagina and the wall of the rectum extending from the anorectal area to the cul-de-sac peritoneal reflections. The presence of this areolar cleavage plane permits a bloodless separation of these two organs, but in no instance does a surgically useful fascia line the vagina or encase it or any of the juxtaposed organs.

In the normal state the anterior vaginal wall meets and fuses with the cervix at an obtuse angle, the degree of angulation increasing proportionately to the amount of retrodisplacement of the normally placed uterus. In the presence of a prolapsed elongated cervix the vaginal wall meets and fuses with the cervix at an acute angle. At the apex of this angle, the bladder wall, instead of coming to a sharp point, curves away from this vaginocervical angulation, thus creating a clear space or blind pocket thinly packed with scattered areolar fibers. A similar blind pocket in both the normal and prolapsed state exists between the cul-de-sac peritoneum as it swings cep-

halad to cover the rectosigmoid and the posterior vaginal wall as it swings caudad from its point of fusion with the posterior cervix. This pocket is packed with a loosely felted areolar mesh. A knowledge of these relationships and of the utilization of precise methods of approach to avascular spaces and cleavage planes shortens operating time, minimizes bleeding and in brief simplifies vaginal plastic surgery.

HARRY W. FINK, M.D.

## MISCELLANEOUS

**Prostigmine for the Cure of Amenorrhea** (La prostigmina nella cura delle amenorree). T. M. CAYVA.  
*Rivista Ginecologica* Tor. 1948 14: 373.

Prostigmine injections were employed by the author in 67 women either for diagnostic purposes in cases of suspected pregnancy or for the treatment of amenorrhea.

In 6 of 10 patients with menopausal amenorrhea prostigmine failed to establish the menstrual flow.

Negative results were obtained also in a group of 7 women with amenorrhea of endocrine origin.

In 14 of 17 patients with amenorrhea without evidence of any disturbance of the endocrine system prostigmine produced menstruation. The injections were not followed by a menstrual flow in any of the 11 pregnant women, but in another group of 4 patients a slight flow followed the administration of the drug, of the 2 abortions in this group only one was possibly attributable to prostigmine. The other was probably provoked by the ingestion of quinine.

The author concludes that prostigmine is an innocuous drug and is valuable for diagnostic and therapeutic purposes.

JOSEPH E. NAKAT, M.D.

**Investigation and Treatment of Infertility.** JOHN ROCK.  
*Rock. Med. Clin. N. America* 1948 32: 1171.

The author has listed and discussed the commonest known causes of failure of fertility and suggestions are made as to how to use easily available methods of identifying these causes and relieving them. Normal health of both mates is assumed.

If anatomic obstruction cannot be overcome by dilatation with glass vaginal forms of gradually increasing size inserted two or three times daily by the patient herself, or if instruction of the too considerate or inefficient husband is futile, recourse must be had to careful plastic surgery.

Bacterial vaginitis can be relieved by semidial 2 quart douches with 0.5 per cent boric acid or sodium perborate solution or by suppositories containing 100,000 units of penicillin inserted twice daily for about 1 week. The trichomonas is susceptible to Degevan tablets inserted morning and night following a douche of 0.5 per cent sodium perborate solution. Flomargin tablets may also be effective.

The number morphology, maturing qualities and to a slight extent the behavior of spermatozoa may be observed and appraised by appropriate methods. So little is known of the essential biochemical and biophysical properties of the seminal fluid, however

that the study of this medium has not yet entered the clinical field. Even the work on hyaluronidase, and on the metabolic functions of spermatozoa and their demands on and utilization of their substrate is still in the stage of research.

When cervical mucus at ovulation time contains pus, there is endocervicitis and possibly endometritis. If of minor degree, the finding of pus may not be significant but it must not be underestimated. The presence of many leucocytes at times other than at the time of ovulation may be physiologic.

For endocervicitis, superficial cauterization and topical medication are valueless. The sulfonamides and penicillin may be of value if given at least during the first 10 days of several successive cycles, in doses adequate for other infections. If the cervicitis is marked, careful and conservative cauterization of the external one half of the cervical canal, supplemented by treatment with antibiotics, is in order.

In the presence of endometritis, other than that which is tuberculous, antibiotics, often without curettage, should be used throughout several consecutive cycles. Formerly tuberculosis was treated by hysterectomy and bilateral salpingectomy. Streptomycin may make such radical treatment unnecessary.

Constitutional hypoplasia of the uterus reflects a disorder of puberty and early adolescence and is exceedingly resistant to available therapy. Treatment is still highly experimental. Theoretically effective doses of estrogens usually will inhibit ovulation. They may be tried for a few months in doses of 2 to 0.05 mgm. of ethinylestradiol or 5 mgm. of diethylstilbestrol with the justifiable expectation that ovulation if stopped will be resumed with the cessation of treatment.

Ignorance doubtless clouds our insight into the complete function of the fallopian tube. Perhaps its fluid normally offers more to the ovum and sperm than a protective medium. At the moment the most we expect of the tube is that it will collect the ovum, transport it to the uterus, and provide a fluid medium in an unobstructed channel through which, also, sperm may travel. For these purposes there must be patency and a lining that secretes fluid and (by means of cilia) convey it with some peritoneal or follicular fluid, into the uterus. Normally mesosalpinx fibers in the tubo-ovarian ligament the mesosalpinx, and well developed fimbria bring about the application of this fan-shaped flaring end of the tube to the vary so as to form a "virtual oviduc."

HARRY W. FICK, M.D.

**Experiences with a New Semisynthetic Alkaloid of Secale Cornutum in Obstetrics and Gynecology** (Esperienze con un nuovo alcaloide semisintetico della segale cornuta in ostetricia e ginecologia)  
ANTONIO GIAROLA. *J. s. Med. g.* 1945, 70: 410.

Stoll and Hofmann (*Helvet. Chimica Acta* 1933, 16: 1045) succeeded in a partial synthesis of tartaric acid (one of the fundamental alkaloids of *secale cornutum*) which resulted in the produc-

tion of methyl ergobasine. This alkaloid differs from the natural alkaloid ergobasine, developed by Stoll and Burckhardt in 1935 in that it possesses a hydroxy-butyrylamido radical in place of the hydroxy-propionylamide radical of the natural alkaloid. The tartaric acid salt of methyl ergobasine was introduced to the attention of the medical profession as methergine in 1943 and has since been employed extensively in the United States and Switzerland in an experimental capacity. This preparation was used at the Obstetrical and Gynecological Clinic at Milan, Italy in 470 cases. Of this number 330 represented obstetrical conditions and 80, gynecological conditions.

Of the obstetrical patients, 100 were in the second stage of labor and the injection was made immediately after the birth of the child, 215 patients were in the puerperal period, the drug being used in place of the usual preparation of *secale cornutum*. 5 patients presented uterine inertia, and 10, puerperal subinvolution. During the discharge of the placenta, methergine exerted exactly the same effects as the natural preparation except that it acted much more rapidly and in the author's material there was no instance of retention of the membranes or incarceration of the placenta. In the puerperium there was not a instance of postpartum hemorrhage or of uterine atony. In the cases of bleeding due to uterine inertia the preparation exhibited an action very similar to that of pituitrin but without the hypotensive effects of the hypophyseal extracts. When the cases of puerperal subinvolution showed evidence of inflammatory involvement, the treatment with methergine was combined with excellent results, with hot douches (45-50° C) and sulfonamides.

The 80 gynecological patients presented 15 cases of metrorrhagia, of probable hormonal etiology in women in the period of sexual maturity; 23 cases of metrorrhagia on a premenopausal dyshormonal basis; 5 cases of metrorrhagia due to a benign neoplasm in the premenopausal period; 34 cases of metrorrhagia accompanied by inflammatory affections of the female genital apparatus; 5 cases of metrorrhagia of the menopausal period but without neoplasm; and 9 cases in which the preparation was administered preoperatively as a prophylactic measure against hemorrhage.

In the metrorrhaegias associated with hyperplastic endometritis the favorable effects resulted in permanent cure when the methergine was associated with active hormonal preparations (corpus luteum, triolein hormones) in appropriate dosage. In the neoplastic cases the results were not good and the methergine treatment had to be supplemented by irradiation therapy to overcome the metrorrhagia. When methergine was given preoperatively there was more or less marked diminution of the bleeding during the subsequent operation however the results depended more or less on the type of operation (retroversion operation, fibroidectomy) as well as on the manner in which the individual patients reacted to the drug.



On the whole the preparation was tolerated perfectly whether given by mouth or parenterally

JOHN W BRENNAN M D

**Present Position of Neurosurgery in Gynecology**  
ALBERT DAVIS. *Brit M J*, 1943 2 585.

The rationale, technique, and results of a variety of operations mainly designed to interrupt sympathetic pathways from the uterus but all concerned with the relief of pelvic pain are described

Resection of the presacral nerve is curative in cases of severe spasmodic dysmenorrhea. Of 86 cases extending over a period of 16 years the results in later cases show a considerable advance over results in earlier cases. The patients operated on before 1934 showed a cure rate of 54 per cent and those operated on up to 1945 a cure rate of 71 per cent. Of 8 patients operated on since that time however only one is not cured and she admits to considerable improvement. This progression is due to a variety of causes: more extensive denervation; more careful peritoneal stripping; and more extensive coincident surgery but the main factor has been increased care in the selection of cases. It has now been established that the only dysmenorrhea for which presacral neurectomy is basically indicated is the primary spasmodic type. Congestive secondary cases may be improved but the result is always problematical. Accordingly it is the author's practice to limit the operation to those patients suffering from intolerable colicky pain centered over the hypogastrium and in whom all minor and operative measures—exercises, antispasmodics, cervical dilatation and alcohol injection—have failed. Under these circumstances he found that 4.8 per cent of patients complaining of dysmenorrhea were suitable for presacral neurectomy. The results of this operation for the relief of pain of incurable pelvic carcinoma in 8 patients has not been encouraging.

Ovarian sympathectomy is effected by the division of the infundibulopelvic ligament near the pelvic brim after mass ligation of the structure. The operation is useful as an adjunct to conservative operations on the adnexae as in endometriosis and in selected cases of mittelschmerz. It is questionable whether the advantages of this operation outweigh the possible dangers of interference with the hormonal function of the ovary.

Alcohol injection of the pelvic plexus is primarily of value in cases of severe spasmodic dysmenorrhea which have failed to react to medical treatment. It should be combined with dilatation of the cervix. Of 61 cases of primary spasmodic dysmenorrhea, 43 (nearly 70%) were permanently and adequately relieved.

Intrathecal alcohol injection is indicated in all cases of visceral pain arising from incurable pelvic carcinoma. When combined with simultaneous alco-

hol injection of the pelvic plexus the results seem to be considerably better. A solution of ammonium sulfate may be substituted for the intrathecal alcohol to circumvent some of the difficulties inherent in alcohol injections. However in a personal case the injection was painful and in neither was there a reasonable degree of subsequent relief.

Section of the uterosacral ligaments chiefly through the vaginal approach is of value in intractable dysmenorrhea but is mainly indicated for the relief of what might be called the posterior parametritis syndrome. The basic pathology of this condition is a uterosacral lymphangitis secondary to cervicitis. The prime symptom is chronic low back ache aggravated by walking, menstruation and coitus and examination reveals the tender contracted cordlike ligaments. The efficacy of this operation is controversial probably due to variations in the depth and extent of the uterosacral division. In 4 cases the results have been disappointing. Uterosacral alcohol injection, epidural block, paravertebral block and chordotomy are briefly presented.

GEORGE BLUNICK, M D

**Study of the Uterine Cavity and of Tubal Permeability in the Fetus by the Method of Hysterosalpingography (Lo studio della cavità uterina e della permeabilità delle tube uterine con il metodo della isterosalpingografia)** P. SROTO and I. ORLANDINI. *Qued clin* and *gyn* 1948 3 400.

Twenty-two female fetuses which were born dead or died soon after birth and were without evidence of maceration and apparently without genital or extra-genital malformations were examined by the same technique as that of hysterosalpingography in the adult living female for sterility. This material comprised 3 fetuses in the third month of intrauterine life, 3 in the sixth month, 4 in the seventh month, 6 in the eighth month and 6 in the ninth month.

In all these cadavers the tubes were permeable, either *in situ* or when the examination was repeated on the excised genital organs. In the work on the isolated organs the technique used was that of Markoff (*Gyn obst Par* 1931 23 323). In all cases the tubes were tortuous in the isthmus portion and undulatory or even spirally coiled in the ampullar portion. In no instance were there evidences of inflammation or of inflammatory sequelae in the tubal walls.

The images of the tubes and the uterus were always uniform for the age of the fetus examined and frequently bore a striking resemblance to those described by other authors for the uteri of women suffering from the congenital form of primary sterility. The cervical cavity tended to be cylindrical without evidence of constriction at the cervicoisthmus junction and the cervical shadow was at least twice as long as that of the corpus uteri.

JOHN W BRENNAN M D

# OBSTETRICS

## PREGNANCY AND ITS COMPLICATIONS

Concerning the Biologic Reaction of G. H. Mainland in the Diagnosis of Pregnancy. Preliminary Studies. (Sulla reazione biologica di Galli Mainland per la diagnosi di gravidanza. Prime osservazioni) *Lectura Novus Rev. del gen.*, 948, 31 252.

In repeating the experimental work on the diagnosis of pregnancy by the Argentine physician Galli Mainland in 1947 the author has been using instead of the frog *Bufo arenarum* of Hensel the common field frog of Italy the *Bufo vulgaris*. The reaction depends, as in the Mainland test, on the finding of mobile spermatozoa in the urine of the male frog following the injection of the serum, or urine of the pregnant woman into the dorsal lymph sac of the frog.

In 36 pregnancies from the first to the third month the test was negative in only 2 (these later showed positive) in 30 advanced pregnancies (from the fourth month on) the test was invariably positive. In a few women during the puerperium the test was positive as late as the sixth postpartum day.

In 3 cases of adenitis, 20 of benign and 9 of malignant tumor 6 of secondary amenorrhoea, 6 of the menopause 3 of disturbed endocrine function, and in 10 more the test was always negative. In 3 ectopic pregnancies there were negative reactions, and in 6 incomplete abortions there were 5. In 10 nonpregnant women there was only 1 positive result.

These figures, together with the constantly positive result following the injection of 0.01 U of the gonadotropic chorionic hormone and the constantly negative results following the use of the other hormones (ovular, luteal, and testicular) confirm the specificity and exactitude of the test. The test has practical value because of the speed of its reaction, the simplicity of the technique, the ease of microscopic demonstration of the spermatozoa, and the economy in procuring and rearing the test animal.

The author will report in future communications a larger material and more extensively on the physiologic basis of the reaction. Further studies will also be concerned with the exact dosages involved and the significance of the time factors present.

JOHN W. BRENNAN, M.D.

Pregnancy and Subacute Bacterial Endocarditis. CURTIS L. MENDENHALL. *Am J Obst.* 948, 36 645.

Prior to the introduction of antibiotics, subacute bacterial endocarditis was a fatal disease. Pregnancy was rarely complicated by this condition. From 1932 through 1947 there have been 10 such cases complicating pregnancy among some 50,000 patients at the New York Living Hospital. Three cases occurred before the use of penicillin and all of the patients died during pregnancy or the puerperium.

Seven patients treated with penicillin survived pregnancy and delivered normal living children. In 5 of these cases the blood cultures proved that subacute bacterial endocarditis existed beyond doubt, while in 2 cases the blood cultures were negative.

A past history of subacute bacterial endocarditis is not a contraindication to subsequent pregnancy. The advisability of childbearing should be determined by the current cardiac status, and treatment should be given accordingly. Pregnancy does not alter the treatment of this disease. The prophylactic use of antibiotics during labor and the early puerperium is suggested to prevent the development or the recurrence of this condition.

JOHN R. WOLFE, M.D.

The Ureogenetic Imperfection Coefficient of Maillard in the Nephropathies of Pregnancy (Il coefficiente di imperfezione ureogenetica di Maillard nelle nefropatie gravidiche) A. FAVINI. *Rev. del gen.*, 948, 3 205.

Thirty-six cases of nephropathy of pregnancy were studied by means of the coefficient of Maillard. Twelve of these were simple cases of albuminuria, 10 were instances of acute nephritis and 5 were cases of eclampsia in pregnancy. The coefficient is expressed by the formula  $\frac{\text{Formol N}}{\text{hypobromite N}} \times 100$ , in which the Formol N represents the ammonium N plus the N of the amino acids, and the hypobromite N represents the ammonium N plus the urea N plus the N of the amino acids. The method was chosen because it was believed to give a fairly comprehensive picture of the functioning of the liver. The results here obtained were then run parallel with those of the Ambard constant in order to determine if these two values respond in the same manner to the vicissitudes, normal and pathological of the functioning of the kidney and liver. The normal average value for Maillard's coefficient is found to be about 5.5.

In the group of simple albuminurias the findings were either within the normal or slightly above, but they were always comparable to the physiologic figures for that period of pregnancy. In these patients the figures in 50 per cent of the cases returned to the normal nonpregnant level within 4 or 5 days postpartum. In the others the period of return to normal was as long as 10 days. In 2 instances in which the original figures had been quite high the coefficient was still elevated at the end of the tenth day in the puerperium. In the frankly nephritic cases the coefficient could again be forced into the limits of normality; however the cases when viewed individually frequently gave figures too high to be explained otherwise than as an involvement of the liver. In this group the return to normal did not occur until from 10 to 15 days postpartum. In the

eclampsia group the figures both for the period of pregnancy and that of the puerperium were quite similar to those given previously.

On the whole the author concludes that the protein metabolism as indicated by the coefficient of Maillard has not been sufficiently consistent or definite in his material (which is admittedly meager and was studied in part during the war years when protein food stuffs were scarce) and therefore cannot serve as the sole indication as to the condition of the protein metabolism in the kidney involvements of pregnancy.

JOHN W. BRENNAN, M.D.

### LABOR AND ITS COMPLICATIONS

Labor in Brow Presentation (*Sal parto nella presenta alone di fronte*) COSSIMO PUTIGNANO, *Riv. ostet.* 1945 3 197

Fifty nine cases of delivery in brow presentation were found among 13,234 births in the obstetrical and gynecological department of the University of Bari in the 20 year period from 1926 to 1945. This represents an incidence of 1.4 per cent. This high incidence is explained on the basis of the reluctance of the women of this region to present themselves at the clinic except for dystocia. In fact, the other common complications of childbirth also make up a high percentage in this material.

The mechanism of development of this complication is discussed in the light of the various theories propounded from time to time (La Chapelle, Manginalli, Pollosson, Marchionnesse, and Alfieri). Special stress is placed on the "open mouth" theory of Alfieri and the clinical and cephalometric study of this theory by Moracci (*Arch. ostet. ginec.* 1946 51 17). Internal Abstr. Surg. 1947 84 76). In the author's material the determining factor could be established in 66 per cent of the cases. The factor in 32.2 per cent was precocious rupture of the membranes in 23.72 per cent pelvic deformity and in 6.77 per cent maceration of the fetus. There was one example each of twins and of placenta previa. Most numerous were the women over 27 years of age; multiparity and fetuses of more than 2,750 gm. of body weight.

When the patient entered the hospital the membranes were intact in 35.42 per cent of the cases and the cervical dilatation was 3 cm. in 18.64 per cent, 5 cm. in 11.86 per cent, 7 cm. in 23.72 per cent and more than 7 cm. in 45.76 per cent. The fetus was alive in 59.32 per cent of the cases, in distress in 23.72 per cent, and dead in 16.93 per cent. The presentation was occipitodextraposterior in 55.93 per cent of these labors, occipitolaevoposterior in 25.42 per cent, occipitolaevoposterior in 11.86 per cent and occipitodextra anterior in 6.77 per cent.

In this clinic an expectant attitude predominated as a rule. The labor terminated spontaneously in 27.11 per cent of the patients, with forceps in 54.23 per cent and with version in 11.86 per cent. Cesarean section was resorted to in 5.08 per cent of the mothers (always because of a deformed pelvis) and embryot-

omy in 16.94 per cent. Hysterectomy with bilateral salpingo-oophorectomy was done in a case of ruptured uterus.

The fetal mortality was 35.59 per cent, this included the fetuses which were dead on admission (16.94 per cent) and those dying after admission. Those dying during the surgical intervention comprised 13.55 per cent and those dying in the course of labor 5.08 per cent. There was a percentage of 27.77 of fetal deaths among the primiparas and of 39.02 among the pluriparas. Among the women with intact membranes on admission the fetal mortality was 20 per cent and among those with ruptured membranes the mortality rose to 43.58 per cent. Spontaneous deliveries resulted in a fetal mortality of only 6.25 per cent; the mortality following the application of forceps was 46.87 per cent and that following the classical version 57.14 per cent. Among the small fetuses the mortality was 30.76 per cent, among those of normal weight it was 37.93 per cent and among the large fetuses it was 41.76 per cent.

The maternal morbidity was 18.64 per cent, however only 1.72 per cent (1) of the mothers died, this mother had a ruptured uterus.

JOHN W. BRENNAN, M.D.

Spondylolisthesis as a Complication of Childbirth (*Ueber die Spondylolisthesis als Geburtskomplikation*) KEIJO SORITA, *Acta obst. gynaecol.* 1948 28 137

The author adds 1 more case of pregnancy in a young woman with spondylolisthesis to the approximately 30 cases of this type already reported. His patient had participated in the work about a farm house had never noted any discomfort and had not noted that she had become shorter in stature. She did not recall that any special stress had been placed on her spine and had had no accidental injury of any kind to her back.

External observation evidenced immediately the peculiar characteristics of the spondylolisthetic individual: her back was short and broad, she had no waist, the chest sitting immediately on the top of the pelvis and she had a deep depression over the area of the lower lumbar spine; this depression terminating abruptly by the sharp offset of the rather prominent upper angle of the sacrum. Roentgenologic examination both before and after the removal of the child by cesarean section showed that the fifth lumbar vertebra had slipped entirely off the anterior surface of the upper end of the sacrum and was resting horizontally with its lower articular surface applied flatly to the anterior surface of the sacrum. This vertebra had of course dragged the fourth lumbar vertebra down with it into an almost horizontal position.

Since the pelvis was not greatly deformed it was concluded that the spondylolisthetic process began rather late after the pelvic bones had consolidated and had perhaps become accelerated to produce the condition found only after the beginning of the pregnancy.

JOHN W. BRENNAN, M.D.

Pethidine and Scopolamine in Labor. HEIDA ROSENKRANTZ. *Brit. M. J.* 948, 590.

A series of 500 patients receiving pethidine (demerol) and scopolamine in labor has been observed. The first dose consists of pethidine, 100 mgm. and scopolamine 1/50 gr (0.43 mgm.) intramuscularly. A second similar dose is given 1 hour after the first, but its administration must be judged according to the merits of each case. Subsequent doses can be given at intervals of 4 to 6 hours, however if possible scopolamine is not given within 2 hours (at least) of delivery as it may promote some non-occlusion of the mother and some respiratory depression of the infant. The maximum dosage of scopolamine in this series was three doses each of 1/50 gr and it was given once a period of 18 hours, together with 400 mgm. of pethidine. The maximum amount of pethidine used in a single case in this series was 500 mgm. and this was given over a period of 30 hours together with two doses of scopolamine each of 1/50 gr. The drugs were generally given intramuscularly but if the patient was suffering unduly and immediate relief was required the first dose was given intravenously.

The degree of relief obtained was good in 53 per cent satisfactory in 38 per cent and fair in only 3.6 per cent of the patients. In 2 patients the degree of relief was difficult to assess. The results do not show any increase in either maternal or fetal mortality rates and the incidence of postpartum hemorrhage is not raised.

There is a suggestion that pethidine and scopolamine may have the effect of shortening the duration of labor. Uterine contractions, as recorded with the aid of an abdominal tambour did not seem to be altered in rhythm or amplitude. The blood pressure and respiration are not significantly affected. In no case could the application of forceps be said to be due to the analgesia. GEORGE BURNICK, M.D.

## PUERPERIUM AND ITS COMPLICATIONS

Epulis and the Puerperal State (Epulis nato puerperale). GIOVANNI L. CO. *Riv. ostet. g.* 948, 3.

Three cases of epulis, developing during pregnancy in young women from 22 to 28 years of age and disappearing completely 2 or 3 months after childbirth, are reported. In all of these patients the dark red violaceous excrescences appeared on the gingival border on the left side of the upper jaw in the region of the canine tooth. In 1 of these the growth returned with a second pregnancy but in this instance it, as located on the right side, involving the area of the lateral incisor tooth. In this patient a biopsy specimen disclosed the typical confused arrangement of sarcomatoid fusiform cells interspersed with huge cells with many centrally located nuclei (myeloplax).

In the third patient the gingival growth started in the lower jaw more or less on the midline and spread somewhat toward the right side. Here a small biopsy specimen near the edge of the growth exhibited the

same sarcomatoid stroma without atypical karyokinesis as in the previous biopsy and without evidence of myeloplax. This growth was quite vascular. After delivery there was the same diminution in size of the growth and the same paling to a normal pinkish color. In this case another biopsy specimen was procured a month after delivery and histologically it exhibited a more mature connective tissue type of stroma cell forming a sort of meshwork around extensive areas of hyaline degeneration of sarcomatoid cells. The blood vessels had also apparently undergone the same hyaline regressive change. The basal layer of the overlying epithelial layer appeared to be undergoing the same type of hyaline degeneration. The epithelial layer was thinner than normal and the epithelial pegs had largely disappeared.

The author suggests that the regression of these growths after childbirth might be the result of the protective action of lactation against the allegedly carcinogenic action of the estrogenic hormone of the ovary and he believes that extracts of the active mammary gland should be tried in cases of epulis developing under nonpregnant conditions.

One thing is certain, and that is that the treatment is not surgical. JOHN W. BRIDGMAN, M.D.

Puerperal Perigenital and Perineal Hematomas. FRANK J. WALSH and HOWARD I. GARDNER. *Am. J. Obst.* 948, 56-59.

Puerperal perigenital and perineal hematomas are accumulations of blood in the perigenital soft connective tissue resulting from the rupture of a blood vessel usually a vein, incumbent on the trauma of labor. Such a complication usually occurs during the descent of the fetus or shortly after delivery. The blood escaping into the connective tissue follows the planes of cleavage of the fascia. When this occurs high in the genital tract, the blood tumor forms within the broad ligaments, fills the pelvis, and may extend retroperitoneally to the region of the kidney or the diaphragm. When low in the genital tract, the hematoma will fill the vagina, distend the perineum and vulva, or displace the rectum or urethra.

Three cases observed at the St. Elizabeth Hospital, Chicago, are presented—1 perineal, 1 vaginal, and 1 supravaginal.

Early incision of the hematoma with ligation or suture ligation of the large vessels and packing of the hematoma cavity is the treatment of choice for perineal or vaginal hematomas. In the supravaginal variety laparotomy is indicated, and hemostasis must be secured even if a hysterectomy is necessary.

JOHN R. WOLFF, M.D.

## NEWBORN

Some Aspects of the Problem of Hemorrhages in the Newly Born (Alguns aspectos do problema das hemorragias no recém-nascido). OTTO CERNY. *Rev. obst. g. S. Paulo*, 947, 8.

Hemorrhage in the newly born may be due to vascular lesions incurred during labor to so-called

hemorrhagic disease of the newly born and to hereditary conditions. Systematic autopsies have shown that natal and neonatal mortality from hemorrhage caused by traumatism of labor is much greater than was hitherto accepted. The most important and the most frequent of these hemorrhages are the intracranial and the suprarenal. Intracranial lesions especially of the septa of the dura mater are nearly always accompanied by hemorrhage. In addition the suction acting on the head of the fetus after rupture of the membranes may produce blood suffusions in the brain. The varying sites of the hematomas and the degree of compression which they exert on the brain cause the variability in symptoms when the child survives labor.

Massive hemorrhage of the suprarenals is nearly always bilateral may reach the capsule, and may result in effusion of blood between the layers of the peritoneum and into the peritoneal cavity itself. In most cases the diagnosis has been made at autopsy but it is possible to make the diagnosis during life. The condition presents the appearance of pneumonia and for this reason has been given the name of pseudopneumonia of the newly born however the true condition can be recognized by means of a careful clinical examination and study of the blood. It should also be noted that cases of hemorrhage due to traumatism of labor tend toward aggravation during the first days of life.

Clifford's concept that hemorrhagic disease of the newly born is a syndrome of spontaneous internal or external hemorrhage associated with hypoprothrombinemia is now generally accepted. In this connection should be remembered the fact that there is a physiologic hypoprothrombinemia in the newly born during the first days after birth under normal conditions the child is born with a relatively high concentration of prothrombin which from the first day after birth decreases gradually and then increases gradually to reach normal values about the sixth day. Thus all newly born are exposed to the potential danger of hemorrhage during the period of physiologic fall in the rate of prothrombin. In addition this prothrombinopenia may turn into a pathologic condition if the natural processes do not promptly help to re-establish a sufficient concentration of prothrombin. Some authors claim that, if the prothrombin rate falls below 25 per cent of normal, hemorrhagic disease ensues. Other conditions may also contribute to the hemorrhagic tendency the liver may be insufficient or incapable of producing prothrombin although the necessary materials are present in the organism, or the bile ducts may be obstructed and, despite normal liver function and the presence of vitamin K in the intestine, this vitamin cannot be emulsified for absorption. And recently some investigators have shown that in some cases of hemorrhagic disease prothrombinopenia cannot be accepted as the direct cause of the disorder.

In rather rare instances the newly born may be a carrier of hereditary abnormalities such as hemophilia, hereditary pseudohemophilia (hereditary hemorrhagic thrombasthenia of Glaxmann thrombopenic hemorrhagic purpura, or hereditary thrombopenic purpura) hereditary hemorrhagic telangiectasia, better known as Osler's disease (disease of Rendu-Osler of Weber or hereditary familial angiomatous disease of Goldstein).

The rate of prothrombin in the newly born can be increased by means of vitamin K administered to the mother or to the child and it would seem that the best effect can be obtained by giving an adequate oral dose (50 mgm.) to the mother from 12 to 4 hours before labor. This method is indicated in all cases in which the occurrence of hemorrhage in the fetus is thought to be likely. Some authors have advised the systematic use of vitamin K in all pregnant women during the last weeks of pregnancy as a prophylactic measure against hemorrhage of traumatic or spontaneous origin or to prevent the usual prothrombinopenia of the newly born. The advantage of this measure is open to discussion. It would be justified in vitamin K deficiency in the mother with repercussion on the fetus. Evidently it could not change the incidence of intracranial and other hemorrhages due to traumatism of labor but it could prevent aggravation of these hemorrhages. It could also be used to advantage in cases in which breast feeding is impossible. However vitamin K should not be the only recourse in cases which do not respond promptly to treatment. For instance in hemophilia the transfusion of whole blood is the only available measure although its results are rather uncertain while vitamin K may help to correct the physiologic prothrombinopenia and thus improve the possibility of blood coagulation.

As the transfusion of whole blood plays a very important part in the solution of the problem of hemorrhage in the newly born, rigorous classification of the blood to be used is imperative. Parents should never be taken as donors however when no Rh negative donor is available, maternal blood may be used for the transfusion of washed red cells.

RICHARD KEMEL, M.D.

#### MISCELLANEOUS

**The Permeability of the Human Placenta to Water and the Supply of Water to the Human Fetus as Determined with Deuterium Oxide.** L. M. HILLMAN, L. B. FLECKNER, W. S. WILKE, G. J. VOSSGARD, and N. K. PROCTOR. *Am. J. Obst.* 1948, 56: 86.

Changes in the permeability of the human placenta to water have been measured from the fourteenth week of pregnancy to term. Deuterium oxide was the tracer material used.

The human fetus receives across the placenta at the fourteenth week of gestation 700 times and at the thirty first week, 3,800 times as much water as is incorporated in the growing tissues.

JOHN R. WOLFF, M.D.

# GENITOURINARY SURGERY

## ADRENAL, KIDNEY AND URETER

**Paraganglioma.** CARLETON A. SMITH. *J Urol* Balt., 94, 60: 697

A case of an extra adrenal medullary tumor (paraganglioma) is presented. The symptoms consisted of paroxysmal hypertension and blanching of the finger tips. Roentgenologic studies showed a soft tissue mass 6.5 by 5 cm. containing flecks of calcium located between the left transverse processes of the second and third lumbar vertebrae. An excretory urogram showed the left ureter to be deflected around this mass. An accurate preoperative diagnosis was made.

Surgical removal was immediately followed by shock which was successfully treated by the subcutaneous and intravenous injection of epinephrine, the intramuscular injection of epinephrine in oil, the intravenous infusion of isotonic solution of sodium chloride, the transfusion of blood, and the use of adrenal cortical extract. JOHN L. ENCKETT, M.D.

**Anatomy of Pararenal Vessels.** BARRY J. ARBON, EARL W. CAULDWELL, JAMES W. PICE, and LINDSAY E. BEATON. *J Urol* Balt., 94, 60: 74

Four hundred and fifty adult cadavers were examined with reference to the pararenal system of veins. This precise and painstaking work by the authors makes it quite clear that the traditionally simple form of renal pedicle commonly portrayed in standard anatomical texts cannot be accepted in the light of critical study of the kidney area. The kidneys receive numerous arteries from varied sources, and venous tributaries converge upon them from both adjacent and remote visceral and parietal structures. The pattern of renal and pararenal vascularity varies within definable ontogenetic limits and the authors describe the more common plans, together with the more usual variations. JOSEPH E. MAURER, M.D.

**Treatment of Bilateral Renal Calculi.** M. S. S. EARLAM. *Austral. N. Zealand J Surg* 94, 5: 6

The determination of the suitability for operation of patients who have bilateral staghorn calculi is difficult. In general three principal criteria are used: (1) the renal function, (2) the degree of urinary infection, and (3) the age and general condition of the patient. The patient should be reasonably young, with good renal function and minimal infection. Other factors to consider are the size and complexity of the branching calculus and the thickness of the remaining renal parenchyma. Occasionally bilateral operation is feasible. In some cases in which the disease is advanced on one side and moderate on the other, conservative surgery on one side and nephrectomy on the other is the procedure of choice.

The most important point in operative technique is adequate exposure, with resection of the twelfth

rib if necessary. Usually the greater portion of the stone can be removed through a pyelotomy incision, the remaining pieces being extracted through nephrotomy incisions. Complete removal of all stony material is most important to avoid recurrence, and should be checked roentgenologically during operation. Postoperative drainage is maintained by means of a nephrostomy tube. In some cases a ureteral splint is left in place for a period of 3 weeks.

Postoperative treatment consists of a copious intake of fluids and chemotherapy. Continuous lavage with Suby G solution through the nephrostomy tube should be done in all cases in which it is suspected that fragments of stones remain, or in cases in which severe alkaline infections complicate the situation.

Long term treatment to prevent recurrence of stone consists of chemotherapy, a permanently increased intake of fluids, and acidification of the urine by means of the acid-ash diet. Adequate amounts of vitamins should be taken. Attempts may be made to reduce the excretion of calcium and calcium solubility without alteration of the pH of the urine by the administration of stilbestrol, or reduction of the excretion of phosphates by the injection of "amphojel."

"Derubitus" calculi (calculi which form during long periods of immobilization) are caused by decalcification of the skeleton and stasis in the renal pelvis and calices during prolonged periods of confinement to bed. The best method of prevention is the liberal administration of fluids and frequent turning of the patient. When this condition is refractory acidification of the urine may be necessary.

Parenchymal calculus is the result of occlusion of the renal tubule by proliferation of the tubular epithelium. The mass of cells degenerates until a homogeneous mass is formed on which calcium salts are deposited. These calcium "masses" or "calculi" usually maintain their position in relation to the pelvocaliceal system, without change for years. Occasionally however they may work their way into the pelvis and be passed.

JOHN L. ENCKETT, M.D.

**Partial Nephrectomy in Renal Hydatidosis (La nefrectomia parcial en la hidatidosis renal).** ENRIQUE A. BORDABERRIE and RUBEN ARANGO. *Rev. Soc. Cir. Uruguay*, 94, 9: 75

Hydatid cysts of the kidney are always intrarenal and subcapsular and when found in the renal cavity always arise from a small base in one calix.

The pathologic and clinical picture consequently will be that which results from mechanical obstruction because of the size of the cyst and atrophy from pressure upon the glomeruli and tubules.

Since a hydatid cyst is considered an encapsulated parasite arising from a small base, modern surgical

procedure calls for the simple removal of the cyst as along with the base and its adjacent tissues. The kidney is no exception in this regard.

Two cases are reported in which partial nephrectomy with complete removal of the cyst was done. Rapid uneventful recovery and permanent cure followed.

STEPHEN J. ZIEMAN M.D.

Cysts of the Mesonephric Tract. E. R. REAY *Anal. N. Zealand J. Surg.* 1948 18 26

The author presents 2 cases of cysts which he regarded as vestigial remains that arose presumably from the wolffian tract. The first patient was a newborn female infant. The cyst presented to the anterior vaginal wall which caused retention of the urine as a result of urethral compression. Needle aspiration and filling with an opaque medium showed a large pelvic cyst which deformed the bladder and pushed it forward. A lower sausage-shaped portion of the cyst extended into the vagina. The contents of the vaginal portion of the cyst were drained and this part of the cyst had not refilled after 6 months.

In the second case that of a man 56 years old there was a large cystic abdominal tumor which displaced the left kidney upward, the ureter medially and the colon laterally. Surgical exploration showed the cyst to be too extensive for removal so the contents of the cyst were aspirated. The lining of the cyst was peeled out and the bleeding was controlled. Microscopic section of the wall of the cyst showed it to consist mainly of primitive renal tissue. The glomeruli were scanty and primitive and showed all stages of atrophy and degeneration.

The author gives the embryologic explanation for the occurrence of these cysts.

JOHN L. EMMETT M.D.

Spontaneous Subcapsular Perirenal Hematoma (Sull'ematoma perirenale sottocapsulare spontaneo) DOMENICO SALERNO *Polidiagnosi ses prat* 1948 55 1137

The etiopathogenesis of spontaneous perirenal hematomas has been and still is the subject of discussion. They are divided into three groups according to their location: (1) the subcapsular which are rare in comparison with the others; (2) the extracapsular which occur in the perirenal fatty tissue and thigh; and (3) the mixed which begin as subcapsular but break through the capsule and become also extracapsular.

The acute forms start suddenly and present nearly always the symptomatic triad of Wuenderlich: sudden violent pain in the lumbar region, irradiating to the entire abdomen but always more intense on the side of the lesion; signs of acute anemia due to increases rapidly and usually assumes the character of an enlarged kidney which may extend upward to the costal margin and downward to the pelvis. Sometimes there are premonitory signs consisting of small colics caused by small perirenal hemorrhages

preceding the large one. The symptomatic triad may be associated with less constant symptoms: hematuria, fever shock, peritonitic signs, subicteric anuria, ecchymosis, scoliosis and roentgen signs of paranephritis.

In the chronic forms, which are much rarer than onset and course are silent and the hematoma is discovered at autopsy or the silent onset is followed by slight, occasional colics due to small hemorrhages which tend to become encysted or there may be only a sensation of weight and painful pulling in the lumbar region.

When Wuenderlich's triad is present, the diagnosis can be safely established but it is impossible before operation in the chronic forms. The prognosis in the acute forms must be very reserved since the mortality to operative cases amounts to about 50 per cent. The prognosis is better in the chronic forms. The treatment can be only surgical and must be instituted promptly.

The author reports a case of acute, spontaneous subcapsular perirenal hematoma in which preoperative diagnosis was nearly impossible because the pain was not as sudden and as violent as in the classical cases and the signs of acute hemorrhagic anemia were sketchy and were not accompanied by a rapidly increasing lumbar swelling. It seems that an exclusively renal origin of the disorder must be rejected since the kidney did not present any tumoral suppurative, tuberculous or hydronephrotic lesions, but showed a picture of paranephritis with acute inflammatory changes in the capsule and moderate inflammation of the cortex. The patient had received a contusion of the dorsolumbar region 8 years previously and another 3 years previously and had been submitted to diathermocoagulation for bladder papilloma 1 year and 3 months respectively before admission and these interventions had been followed by cystitis and pyelitis. Consequently the occurrence of the allergic phenomenon of Sanarelli-Schwartzmann could be invoked as explanation of the disorder. According to this interpretation there would have been the following succession of events: (1) contusion of the lumbar region with probable production of a local hematoma, a site of minor resistance into which bacteria gained a foothold by the hematoma route with resulting paranephritis; (2) oedema of the kidney with introduction of special angiotoxicins which determined a new and considerable hemorrhage. From this point of view the case may be regarded as a typical and rare example of subcapsular perirenal hemorrhage probably due to allergic changes in the perirenal vascular system.

RICHARD KEMEL, M.D.

Mesoblastic Nephroma in Adults. ORMOND S. CULP and FRANK W. HARTMAN *J. Urol.* Balt. 1948, 60 551

Embryonal tumors of the renal cortex have been reported with more than 50 different pathologic diagnoses. The resulting confusion in nomenclature

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has no parallel in either urology or pathology. After meticulous histologic study of several of their own bizarre kidney tumors, and a review of the literature the authors are convinced (1) that most of these tumors are closely related neoplasms rather than distinct morphologic entities, (2) that such tumors vary too much in cellular structure and architecture to permit minute morphologic classification in each instance, (3) that attempts to create new categories for the more complicated tumors have caused most of the confusion which now exists, and (4) that some of these embryonal tumors are so grotesque that even capable pathologists will not agree on the final morphological interpretation.

Because of this chaos, the authors attempted to review all of the malignant cortical tumors in adults which seemed to be of embryonic origin and from the maze of earlier reports and the study of 8 embryonal cortical tumors in adult at the Henry Ford Hospital they have attempted to evolve a simple and practical classification of embryonal kidney tumors to clarify when possible, and when necessary, and eliminate when doubtful the previously reported tumors, and to analyze the clinical behavior of the tumor groups.

Malignant tumors originating in the cortex have been grouped as (1) carcinomas arising from mature renal tubules (clear cell and adenocarcinoma) and (2) embryonal tumors derived from the renal blastema.

(Of the embryonal cortical tumors the mixed tumors have attracted most attention and the most acceptable concept of their development has been uncircumvented by Bell. The renal blastema is composed of rather primitive mesenchymal cells and it is possible that they retain multipotential properties. These tumors are embryonal in origin. Furthermore, the parent multipotential cells are capable of producing a great variety of morphologic pictures. All of these tumors have an inherent potential for mixed histology but occasionally one cell type may dominate the picture.

For the sake of simplicity and accuracy the authors suggest that the term Wilms tumor be abandoned. They have selected embryonal nephroma as the most accurate term to describe all renal tumors of embryonal derivation. Embryonal nephromas, in turn, may be divided into (1) those of mesoblastic origin (cortex) and (2) those of mesonephric origin (pelvis).

Mesoblastic nephroma therefore is the name of choice for the tumors which they have studied. It specifies location, derivation and cannot be confused with other groups. Only 4 subdivisions are needed to embrace all of the morphologic variations: (1) mixed, (2) carcinoma, (3) sarcoma, (4) undifferentiated.

Mixed cell type. These tumors contain both epithelial and connective tissue elements in the primary endoderm. The degree of differentiation and resulting morphologic pictures vary considerably. The

so-called Wilms tumors have been included in this group.

Ninety-seven of these mixed tumors were collected from the literature and four cases of the authors were described in detail. These then are by far the most common type and the most representative of mesoblastic nephromas. Analysis revealed that the age spread was from 16 to 80 with the greatest incidence during the sixth decade. There was no significant difference noted in the sex distribution or the site of the tumor.

Urologic symptoms varied from a few asymptomatic and unsuspected tumors discovered at autopsy to advanced stages of generalized metastases accompanied by large palpable masses, gross hematuria, and severe pain. Eighty-four per cent of these patients had a palpable mass, 72 per cent complained of pain on the affected side, and 53 per cent had some degree of hematuria. Only 14 of the 64 analyzed cases presented the complete triad of mass, pain, and hematuria. There was nothing pathognomonic of any special type of renal tumor. The average duration of symptoms was 2 years and 7 months but 11 cases were excluded the average was 33 months.

Sixty patients were known to have nephrectomy. Most of these were done through the conventional lumbar incision. Fifty-five of the patients treated by nephrectomy had follow-up studies, and 35 of these died with a known mortality of 83 per cent. Most of the postoperative deaths occurred during the subsequent 12 months. Most of the patients treated in recent years received postoperative irradiation.

Autopsies were reported in 32 cases. Local recurrence of the tumor was the most common finding. Metastases were found most frequently in the regional lymph nodes, lungs, and liver. Ten patients were reported well from 3 months to 15 years after nephrectomy.

Study of successful cases revealed that there was no correlation between survival and either the size of the tumor or the individual histology as recorded in the original report. Transperitoneal nephrectomy seemed to have no advantage over the lumbar operation except to aid removal of extremely large tumors.

Carcinoma. Embryonal carcinomas are probably more common than the literature would imply. The authors believe that embryonal carcinomas are potentially or actually mixed cell tumors in which the epithelial elements have completely dominated the histology. The resulting pictures vary from the embryonal adenocarcinoma to the undifferentiated type with alveolar and solid cellular arrangements as intermediate degrees of malignancy. Ewing states that characteristic tumor. Eighteen adults is a rare but characteristic carcinoma. Most cases were found which seem to belong in this adult study to which the authors add 3 case reports. Most of the patients with embryonal carcinoma died following nephrectomy. No significant differences could be found between this small group and the mixed cell tumors, except the histological variation.



**Sarcoma.** The sarcoma group was the most confused and the most difficult to review satisfactorily. In the early literature sarcomas were diagnosed on gross examination alone by bits of tissue removed through ureteral catheters and even on the assumption that any bilateral renal tumor must be sarcoma. Today the sarcomas are confused with undifferentiated carcinomas. The only tumors that right fully belong in this group are neoplasms composed only of embryonic connective tissue elements. The authors found one such tumor in their series and after careful examination of 114 reported cases in adults, they selected 30 which may belong in this embryonal group. The others were omitted because of their incomplete morphologic data or because of obvious origin in the renal capsule.

Renal sarcomas have varying microscopic pictures and have been grouped as fibrosarcoma (including spindle cell type) myosarcoma (including leiomyosarcoma and rhabdomyosarcoma) liposarcoma, lymphosarcoma, osteoblastic, and undifferentiated. These subdivisions illustrate the extreme multipotentiality of the parent cells and represent increasing degrees of malignancy.

The clinical analysis of this group closely paralleled the mixed cell tumors. No significant differences were found in sex or site of the primary growth. Symptomatology was similar to that of the mixed cells with no diagnostic signs or symptoms indicative of sarcoma per se.

Most of the patients were nephrectomized and died soon thereafter despite postoperative irradiation in many cases. Local recurrences of the sarcomas were common and metastases were found most frequently in the lymph nodes, lungs and liver. No correlation was found between survival and the type of sarcoma.

**Undifferentiated.** Most of the highly malignant cortical tumors composed of very primitive cells can be identified as either undifferentiated carcinomas or undifferentiated sarcomas. Smith mentioned an embryoma in which he thought it was impossible to recognize either epithelial or connective tissue elements and designated it as a completely undifferentiated tumor of embryonal origin. This 63 year old patient died.

The authors summarized that after reviewing the literature and studying 8 of their own embryonal cortical tumors, they are convinced that all these embryonal neoplasms are closely related rather than distinct morphologic entities. They suggest that they be called mesoblastic nephromas and that more complicated pathologic terms as well as the name Wilms tumor be avoided.

These tumors occur at any age in both sexes in either kidney, usually are very malignant and tend to recur after either lumbar or transperitoneal nephrectomy, they metastasize to lymph nodes, lungs, and liver most frequently cannot be distinguished from other renal neoplasms clinically and appear to be influenced very little by irradiation. The clinical course usually is rapid and most

deaths occur within 12 months of diagnosis and treatment regardless of the specific tumor type.

Like other malignant tumors operative cures will depend on very early recognition and even then survival will probably be confined to the few mesoblastic nephromas with relatively low malignancy.

ROBERT O. BRADLEY, M.D.

**Adenocarcinomas of Kidney.** JAMES D. FRYFOOLE, MALCOLM B. DOCKERTY, O. THORON CLAGGETT and JOHN L. EDMETT. *J. Urol.*, Balt., 1948 60 321.

The authors of this article wish to present a specific group of tumors that show a constant microscopic cellular differentiation, the dark-celled adenocarcinomas and to correlate the clinical, surgical and post-operative records with the pathologic study which they made.

Seven hundred and sixty-eight malignant neoplasms of the renal cortex were examined grossly and microscopically. The fresh frozen section technique with Terry's polychrome methylene blue stain was used to rule out those tumors presenting the typical hypernephroma picture of the clear vacuolated cell types. Because of the necrotic condition of some of the tumors and the difficulty of using the fresh tissue stain on formalin fixed material all doubtful lesions were recut and stained with hematoxylin and eosin.

An effort was made in this study to compare the cytologic characteristics of the dark-celled carcinomas with normal renal histologic structure. Specimens of normal kidneys were taken from a 7 month stillborn infant and from subjects in each decade through 70 years of age in an effort to find a microscopic picture compatible with the renal strain of the varied age groups. None of these subjects had died from renal disease yet evidence of epithelial regeneration especially about the glomeruli in the older kidneys was seen. In 2 of the subjects more than 40 years of age glomerular capsular proliferation with compression of the tufts was noted. These proliferating cells were small and darkly stained and had faint basophilic granulations. The epithelial cells forming the crescents presented varying stages of fibrosis. The intracapillary cytologic pattern showed no significant changes except in 1 case in which hyalinization marked previous glomerulonephritis.

Careful study of the component parts of the tubule showed cells of clear cytoplasm lining the proximal and distal convoluted tubules. Horizontal sections through the medullary rays provided sections of Henle's loop.

Two factors contribute to the continued use of the term "hypernephroma" even though the origin of cortical carcinomas is now established as being the renal parenchyma. (1) The historic use of the term and the extreme controversy when it was introduced and (2) the confusion of names applied to cortical malignant lesions by two main groups, the radiologists and the pathologists. The fallacy of classification of any group of tumors on the basis of clinical

benefit derived from roentgen rays without pathological support is evident.

Likewise, the abundance of patterns seen microscopically in cortical malignant lesions should be proof in itself of the inadequacy of classification on this basis.

Cytology as a basis for classification has been dismissed because both dark-celled and clear-celled strands are usually seen in the same tumors.

For these reasons teachers have been reluctant to discard the term "hypernephroma," which although genetically false is understood by all to mean a malignant renal tumor.

For the sake of clarity the authors too have used the term "hypernephroma" in the microscopic reports but after being confronted with a lesion that in no way gross or microscopic, resembled Grawitz original description, examining all the other "hypernephromas" removed at the clinic, and writing this article they are convinced that the dark-celled adenocarcinoma is a tumor entity in itself and deserves recognition as such.

In the authors' series, 13 of the patients had extrarenal extension. Of these only 4 survived for long periods: 1 whose lesion was graded 3; 1 with aortic nodal in volvement and 1 with a venous thrombus. All 4 patients were women.

With an average of symptoms measured in months prior to diagnosis, it does not seem logical to assume that in clinic patients the diagnosis is made earlier than elsewhere. Those patients who at operation had widely disseminated or high grade lesions died from their tumors in the same manner and time intervals that are recorded for all types of cortical malignant lesions be they clear-celled dark-celled or mixed.

The survival of patients with large tumors (from 1,000 to 3,400 gm. in weight) is of interest. These patients were all women.

The close microscopic resemblance of embryonal dark-celled tubules and the exactness of the microscopic picture of dark-celled adenomas to the tumors under discussion point to the possible site of origin.

In the present series there were 30 cases of pure dark-celled adenocarcinomas (3.8 per cent of cortical malignant lesions). Their diagnosis cannot be made as such preoperatively but it is suspected by alteration of the gross color and ill-defined encapsulation and is proved by multiple microscopic sections showing only the dark granula cells. The tumors differ from mixed and from clear-celled adenocarcinomas in that they contain little or no intracellular fat, they appear to occur more frequently in women than in men, and that the most frequent symptom complaint is that of a mass. They frequently calcify and regardless of size, if the tumor is removed before extrarenal extension occurs the patients especially the women have long-term survivals. The prognosis in this small series was somewhat better than for hypernephromas.

Of 30 patients 8 underwent operation within the last 5 years, 1 patient was followed up for only 3

years which left 20 patients eligible for the calculation of a 5 year survival rate. Ten patients (50 per cent) lived 5 or more years after operation. Although the series is small it is interesting to note the difference between the survival rate among men and women. The 5 year survival rate for men was 25 per cent (2 of 8) as compared to a 67 per cent (8 of 12) 5 year survival rate for women. Also, all of the long term survivals occurred in women. These were 21, 22 and 31 years postoperatively.

**Late Results of Surgical and Nonsurgical Treatment of Ureteral Calculi Studied with Excretion Urography** (I risultati lontani della cura chirurgica ed inchiostro della calcolosi ureterale studiati con urografia di eliminazione) L. Gurgian, *Ann. Ital. Chir.* 94:8 25:353.

In an attempt to verify the condition of 30 patients with ureteral calculi treated at the Surgical Clinic of Pisa from 1927 to 1947 Gurgian found that 10 could not be traced and 4 had died (3 from general diseases and 1 following operation for lithiasis of the contralateral kidney). 5 wrote that they were well but refused to come to the clinic for examination, and the remaining 11 of whom 8 had been treated surgically and 3 nonsurgically from 9 to 20 years previously agreed to submit to excretion urography and the usual urine examinations. Three roentgenograms were taken of each of the 11 patients one before injection of opaque substance to determine the eventual presence of calculi another during the first minutes after the injection, and the third from 20 to 35 minutes after the injection. Chromocystoscopy was performed in 2 patients in whom excretion urography was completely negative.

From the clinical point of view the late results of both surgical and nonsurgical treatments may be said to be good if not optimal, since all patients after removal or elimination of the calculus have been in excellent health and have not experienced any significant disturbances of the urinary system. From the functional point of view the excretion urography showed normal results in 8 patients, a slight alteration in 2 and complete absence of function in 1 patient.

From the morphologic point of view there were ectatic changes in the renal pelvis and the ureters of 6 patients (4 cases were septic). In 1 patient the change could not be demonstrated because of complete absence of elimination of the opaque substance but there was no doubt about its presence since lumination of indigo failed. In addition, ureteral catheterization revealed stagnation of fluid which was clear like water. In another patient no picture was obtained by excretion urography. In the remaining 3 patients there were no morphologic changes worthy of note.

In conclusion it may be stated that in the absence of serious infectious complications the treatment of ureteral calculus should always be conservative with regard to the kidney because the late results are good even in kidneys that are partly altered in their

morphology and function Besides there is always time to remove a kidney which functions only partially and which after all constitutes a functional reserve for the organism. RICHARD KEMEL, M D

## BLADDER, URETHRA, AND PENIS

**Spontaneous Rupture of the Urinary Bladder** A. RUSSELL TAYLOR *Brit J Urol* 1948 20 117

The author reports a case of spontaneous rupture of the bladder in a patient with compression fracture and complete paraplegia with loss of sensation up to the inguinal region. He modifies the classification of spontaneous rupture of the bladder by stone as follows

1. Inflammatory lesions of the bladder wall (a) intramural in origin including tuberculosis of the urogenital tract particularly of the bladder wall itself (b) extramural in origin
2. Malignant disease of the bladder wall (a) vesical (b) intravesical (c) extravesical
3. Obstructive changes at the bladder neck (a) prostatic enlargement—benign malignant, and inflammatory (including seminal vesiculitis) (b) calculi (c) paralytic, due to interference with the nerve supply of the bladder wall (d) uterine and adnexal disease (e) occurring during labor
4. Obstructive lesions in the urethra (a) stricture—organic or spasmodic (b) valves diverticula—usually congenital (c) tumor (d) calculi (e) penile inflammation (f) penile urethral tumors
5. Overdistention of the bladder due to alcoholism.
6. Ulceration of the diverticulum due to a retained phosphatic concretion.
7. Degeneration of the musculature of the bladder wall appearing as areas of fibrosis or necrosis from any cause. *Example* fatty degeneration or syphilis
8. Pressure from a drainage tube
9. Internal violence due to lavage of the bladder with overdistention of the diseased wall

JOHN A. LOFF M D

**A Contribution to the Treatment of Diverticula of the Bladder** (Contribution au traitement des diverticules de la vessie) GUY VIOLET *J urol med* Par 1948, 54 451

Observations on 33 patients with diverticula of the bladder led the author to the following conclusions

Whenever an obstacle can be demonstrated in the bladder it should be removed and unless there are some contraindications a diverticulectomy should supplement the removal of the obstacle. If no obstacle can be detected a diverticulectomy alone may be expected to produce cure and therefore resection is superfluous. The extravesical approach is the method of choice.

The preoperative treatment includes the introduction of a retention catheter and repeated irrigations of the bladder until the urine becomes clear. Urographic examinations are indicated. Penicillin is given for prophylactic purposes.

If the diverticulum can be easily exposed and isolated through the extraperitoneal extravasical route it may be necessary to incise the formation and to dissect it after the introduction of a finger into it in a manner similar to the isolation and removal of a hernial sac. A drain is inserted into the paravesical space at the termination of the operation and penicillin is given until the temperature remains normal for at least 48 hours. Unless an infection is present, a retention catheter may be employed in place of a cystotomy for the drainage of the bladder.

The author's remarks do not pertain to patients with congenital malformations or those in whom local or general conditions contraindicate surgical intervention.

JOSEPH K. NARAT M D

**A Pathologically Displaced Upper Femoral Epiphysis as a Foreign Body in the Urinary Bladder** E. SANDER, *Brit J Urol* 1948 20 114

The author reports the case of a pathologically displaced upper femoral epiphysis as a foreign body in the urinary bladder in a young male 14 years of age who was hospitalized for a swelling in his left knee with limited motion of the left knee and hip and a sinus over the sacroiliac joint. He also complained of painful and frequent urination. He gave a history of having been injured in a basketball game about 2½ years previously. This injury which consisted of laceration of the left thigh subsequently became infected and drained for about 7 weeks. Shortly after this several metastatic abscesses developed which were incised and drained. About 6 months later a plaster spica was applied to the left hip after forceful extension. Fifteen days later the patient noticed that his urine became turbid and that it contained shreds. There was also a hematuria in increased frequency and nocturia.

Since the patient's illness in February 1945 there had been a slight swelling of the left buttock accompanied by pain. In January, 1947 this swelling opened spontaneously and drained a thick odorless pus which gradually became thinner and then subsided completely.

Examination of the urinary tract revealed these essential findings: the urine was turbid and contained shreds of mucus and pus; culture of a catheter specimen of the urine showed the presence of *Staphylococcus aureus* on passing a sound into the bladder a click was heard denoting a hard foreign body.

Roentgenograms of the pelvis showed an inflammatory process involving the left sacroiliac joint with an almost complete destruction and flattening of the acetabulum, and an upward displacement of the neck of the femur without any evidence of the head. Over the left ischial spine at the brim of the pelvis there was a big rounded shadow about 1½ inches in diameter. A lateral film showed this to be the head of the femur displaced anteriorly.

After a study of intravenous pyelograms it was decided the head of the femur was free in the bladder and a cystotomy was performed for its removal.

JOHN A. LOFF M D

On Tumors of the Bladder with Particular Attention to Their Clinical Classification and Prognosis. P. I. TUOVINEN. *Ann chir gyn-fenn.*, 948, 371 Suppl. 5

This comprehensive monograph is based on a study of 260 patients with tumors of the bladder who were treated at the First Surgical Clinic of the University of Helsinki during the years from 1925 to 1946. The author delineates the finer points in determining the transition from a benign to a malignant state and by successive repetitions emphasizes significant signs. Thus the suspicion of malignancy exists when tenesmus is associated with hematuria. A congested mucous membrane frequently indicates malignant infiltration as does rigidity and roughness or raggedness of bladder contour (noted in the cystogram). In a similar manner by repetitious statistical studies the author seeks to justify his clinical classification of bladder tumors and the modalities of treatment which are recommended.

The classification is based on cystoscopic and cystographic findings and on the clinical course. Histological diagnoses are not reliable although verification of clinical diagnosis by such means is of value. There are then, three groups: benign papillomas comprise 55 cases; a second group is comprised of 78 cases of malignant papillomas and papillary carcinomas which are often difficult to distinguish from each other; the third and largest group is comprised of solid carcinomas. There are 5 undefined tumors. It is evident, however, that complete accuracy in classification is lacking since several of the patients with benign tumors (as noted in late follow-up reports) have died of malignancy. Further the unpredictability of tumor behavior is borne out by a better classification in the early stages of almost one half of the cases which ultimately were designated as belonging to group 3.

There are two main forms of treatment: conservative (electrocoagulation) and operative. Under the latter modality the author lists "sectio alta," (suprapubic cystotomy) with diathermization of the tumor resection of the bladder and cystectomy (used in only 3 cases).

In the case of benign papillomas particularly the best results were obtained by conservative measures (used in 38 patients). At 5 years 74.7 per cent of the patients were living and after 10 years 65.2 per cent were living.

Results of open operative procedures were less satisfactory even allowing for the greater severity of involvement which made this modality preferable. After 5 years 50 per cent of patients were living and after 10 years 30.8 per cent were living. The author is particularly disappointed with "sectio alta" and diathermization. This procedure does not prevent recurrences; does not remove all the tumors in multiple growths and may amount only to a somewhat radical method of obtaining a biopsy. In this tumor group, open operation should be performed in cases of malignant degeneration, in cases which hemorrhage has occurred or in the presence of other com-

plications in which conservative treatment is inadequate.

Among the cases of malignant papillomas and papillary carcinomas of a more serious nature in a higher age group (60.4 years as compared to 55.7 years in the group with benign lesions) the mortality was higher. Here too conservative treatment was more satisfactory and 34.8 per cent of patients were alive after 10 years as against a corresponding figure of 18.6 per cent for the operative cases.

In patients with solid tumors the prognosis is poor. At the end of one year 32.2 per cent of patients were alive following electrocoagulation or x-ray therapy as compared to 22.6 per cent following operation. In this collection of 122 solid carcinomas, 33 were not treated and the end results were no worse than for those operated upon openly.

By way of complementary observation the author noted a marked tendency of all bladder tumors to recur. However it is believed that these recurrences may often be affected mucosal areas which have been insufficiently treated. Most tumors are localized to the trigonal area or to regions about the ureteral orifices. Less than 10 per cent of the tumors involved the vertex. Metastases are not a common finding on clinical examination, and at autopsy metastatic involvement was found in only one-fourth of the cases. Death usually was due to stasis and infection of the upper urinary tract.

The author concludes that the treatment of choice will gradually come to lie between radiology combined with endovesical coagulation and cystectomy. Abstractor's note: This opinion will not find ready acceptance in the United States where there is a tendency to drift away from roentgenological therapy which most of us believe has only temporary qualities and frequently induces a cystitis that is worse than tumor disease. We are however doing earlier and more numerous cystectomies although segmental bladder resection, with removal of adequate (2 cm.) coils of normal tissue is still a good operation in suitable instances.

ALLAN K. SWERSE, M.D.

Carcinoma of Urinary Bladder. JOHN R. M. DONALD and ORRANOM J. THOMPSON. *J. Urol. Balt.*, 948, 60: 435.

It was believed that a study of a sizable group of surgically removed carcinomas of the urinary bladder might be worth while if the accompanying bladder were available also. Many investigations have been made on vesical neoplasms by utilization of tissue removed transurethrally but in such studies only a portion of the underlying bladder at most, can be studied. Information which the surgeon obtains from the pathologist is oftentimes woefully inadequate as applied to the method of treatment which should be employed in such a case. Furthermore, when surgical therapy is given such a patient suffering from a carcinoma, the factors concerning prognosis have been vague, much more vague than in cases of carcinoma elsewhere in the body.

From a histologic and anatomic study of 274 vesical tumors in which all or a portion of the urinary bladder along with the tumor had been removed surgically certain features were determined to be of great importance in the matter of prognosis and cure: (1) whether invasion had or had not occurred (2) when the invasion had occurred whether the fat was or was not involved (3) whether evidence of invasion of the veins or lymphatics was present or absent and (4) the cytologic and anatomic type of tumor whether it was transitional-celled squamous-celled or adenocarcinoma or a mixture and whether it was papillary or nonpapillary.

**Management of Injuries of the Urethra.** ANGEL I RYER. *Philippine J Surg* 1948 3 143

Twenty male patients whose ages varied from 12 to 65 years were treated for injury to some segment of the urethra. Eleven were treated within 24 hours after the injury; the remaining 9 patients had sustained their injuries from 3 months to 4 years before the author saw them. In 3 cases the injuries were caused by shrapnel. All others occurred as a result of straddle falls or truck accidents.

The author claims that the bulbous urethra is injured most frequently during straddle falls and that the membranous urethra escapes during this type of trauma because of protection by the triangular ligament. The majority of patients with injury to the membranous portion of the urethra had suffered fracture of the pelvis.

Unsuccessful catheterization, inability to urinate, arethral bleeding or perineal hematoma prompted operation. The author urges early re-establishment of urethral continuity; diversion of urinary flow by suprapubic cystostomy; exploration of questionable cases the use of an indwelling urethral catheter for 3 to 4 weeks if the injury is acute (or for 5 to 6 weeks in an old case) and postoperative dilatation until the urethra can accommodate a 26 French sound. Most of the author's operations included perineal exposure and repair of the damaged urethra.

No deaths occurred among these 20 patients. Among the cases of acute injury complications—a stricture which was treated promptly—occurred in only 1 case. Strictures with or without fistula, incontinence or calculi, were present in all cases of long standing when first seen. Some patients were followed for as long as 2 years after operation while others had not been seen by the author for a period of 6 months.

ORMOND S CULP M.D.

**Should We Operate on Urethral Stricture? (Sollen wir die Urethralstriktur operieren?)** A. LEHNER. *Helv. chir. acta*, 1948, 15 385.

The author discusses the expediency of resection of the entire stricture site followed by exact suture for cases of urethral stricture in which the passage of bougies becomes increasingly difficult and is followed by reaction, in which the stricture as a chronic ulcer gives rise to constant pain and causes a high grade of incapacity for work, and for cases in which the firm

pressure sensitive stricture must be considered as a granuloma which discharges pus constantly and underrates a stimulus urethritis. The indications for operation are more urgent when a stricture that can be treated only with difficulty leads to obstructive retention and the elevation of urinary nitrogen values in the blood.

Improvement of the results of suture either for primary urethral injury or following resection of immobile stricture can be achieved only when complete cicatrization of the mucosa can be guaranteed with greater certainty. A method which assures rapid cicatrization of the mucosa is yet to be discovered. Since the danger of new stricture formation is just as great following resection and suture as following primary suture the regular passage of bougies is indicated following operation.

JOHN L. LINDQUIST M.D.

**Congenital Absence of the Penis.** SIX HAROLD GILLES and R. J. HARRISON. *Brit J Plast Surg* 1948 1 8.

The authors report 2 cases of true congenital absence of the penis together with a third borderline case. They discuss the embryological factors and a method of phalloplasty.

Stage 1 of the operation designated the three in one incorporates (1) the urethra inside (2) the tubed pedicle together with (3) the cartilage. The cartilage is embedded in the fat of the tubed pedicle in similar fashion to that described by Frumkin but the tubed pedicle is cut on a marked curve. On the skin of the abdomen medially to the tubed pedicle a rectangular piece of skin is marked out of a width of 4 cm. by whatever length of urethra it is necessary or desired to fashion in the particular case. This rectangle is incised skin deep on both its long sides (that on the outer being of course part of the inner incision for the tubed pedicle). On both sides of the rectangle the skin is now undermined superficially to one third of its width. Each edge can thus be lifted toward the center so that they can be sutured together to form a skin tunnel. The long narrow flaps receive their blood supply from the undisturbed central third. To facilitate this maneuver a No. 10 catheter is attached by adhesive down the center of the rectangle and as the flaps are undermined they can be made to adhere to the sides of the catheter so as to facilitate suture. The raw edges of the two long turned flaps are now sutured with fine catgut. One layer of sutures is adequate care being taken to invert and appose the edges accurately.

There is now a skin lined tube surrounding the catheter and a raw surface on either side and over it. The medial cut edge of the abdominal skin is now widely undermined so that it can be pushed toward the middle to make room for the superimposition of the tubed pedicle flap. The tubed pedicle flap is now cut and raised.

In 3 weeks (stage 2) the pedicled flap is again raised but on this occasion the urethra is dissected with the pedicle and its remaining skin connection

at each end is divided. The two long edges of the tubed pedicle flap are now united round the urethra with interrupted or continuous end-on mattress black silk sutures. At this same operation the lower end of the pedicle may be increased in length downward toward the pubis. It should be noted that the thoracoepigastric vein should be included in the main line of the pedicle. The raw area caused by this operation is similarly grafted with a dermatome skin graft.

At 5 weeks (stage 3) the pedicle may be freed at its upper end and brought down to make a direct union with the existing urethral opening.

JORR A. LOER, M.D.

### GENITAL ORGANS

**Physiologic Pathology and Conservative Treatment of Hypertrophy of the Prostate** (Die physiopathologie und nichtoperative Behandlung der Prostatahypertrophie) KORN WILDMOET. *Arch. chir. acta*, 945, 5, 51.

Hypertrophy of the prostate is found in 73 per cent of men over 60 years of age and in 100 per cent of those over 70. As to the etiology, the author attacks the widely accepted theory of Getzenborfer—that the involution of the senescent testis leads to decreased production of the male hormone, and that the prevalence of follicle hormone causes proliferation of the originally rudimentary perurethral glands of the prostate and simultaneous atrophy of the true prostatic parenchyma. Based on this theory treatment of prostatic hypertrophy with male sex hormone has been performed to a great extent.

Two facts speak against this theory: (1) the sometimes dramatic effect of castration (in 87 per cent of the cases the symptoms improve, and the volume of the prostate decreases) and (2) the failure of treatment with testosterone to affect the symptoms and signs of benign hypertrophy. Prostates removed after long continued hormonal treatment do not show any histological difference from prostates of untreated patients.

On the other hand treatment with follicle hormone gives excellent results if the doses are high enough and it obviates prostatectomy in many cases. The author suggests a dose of 3 mgm. of stilbestrol daily until 125 mgm. are given. This series is repeated once or twice yearly. The side effects (gynecomasty, loss of libido) disappear soon after the stilbestrol has been discontinued. The danger of mobilizing a quiescent carcinoma by this high dosage of follicle hormone appears negligible and is outweighed by the advantages of the treatment.

The author criticizes the tendency of American urologists to operate on all diagnosed prostatic hypertrophies and gives more conservative indications for surgery. Only if the residuary urine is more than 200 c.c. or if the sleep and general condition of the patient are disturbed considerably should surgery be done. With conservative treatment, the condition was progressive in only one-third of his pa-

tients and led to operation. In another third the prostate condition remained stationary and in the last third it showed spontaneous involution.

No theory of his own as to the pathogenesis of prostatic hypertrophy is presented by the author.

WERNER M. SOMMER, M.D.

**Surgical Treatment of Prostatic Hypertrophy** (Traitement opératoire de l'hypertrophie prostatique) CH. FERRIER. *Arch. chir. acta*, 945, 15, 166.

The author presents a brief review of the different technical procedures used in surgery of the prostate. Four routes of approach are possible: the transurethral, perineal, suprapubic, transvesical, and retro-pubic prevesical.

Transurethral resection is a difficult operation that requires great practice and experience. The mortality is not negligible if resection is performed only in cases in which prostatectomy is contraindicated. However the reported percentage of mortality varies so much according to different statistics that it is hardly possible to form a correct judgment. The resection should not go beyond the frenum of the verumontanum.

In perineal prostatectomy it is important to spare the external and, if possible, the internal sphincter. Also the coelliculus seminalis should and can be spared as the adenomas always develop superiorly to it. The advantage of this method is that it causes fewer general complications and less surgical shock than the transvesical prostatectomy. The patient gets out of bed on the fourth postoperative day. Its disadvantage is the danger of urethroperineal or urethrorectal fistulas, and of impotence.

The suprapubic transvesical method is easier technically and permits more exact hemostasis, especially with the improvement devised by Harris. It avoids the danger of fistulas and of impotence. However it is a more formidable operation and should be risked only if the general condition, and the circulatory and renal functions are satisfactory. In cases of marked renal insufficiency the operation should be performed in two stages. Bed rest for 20 days is required after this operation.

The most recent method of prostatic surgery is by means of the retropubic prevesical approach, devised by Jacobs and Casper in 1933 and modified by Millin in 1945. This operation does not involve the danger of fistulas or impotence. The convalescent period is practically painless and much shorter than after the transvesical operation. However the operation is technically more difficult, especially in obese patients. In cases in which the transvesical method is too hazardous because of renal or circulatory insufficiency the Millin operation is the procedure of choice.

WERNER M. SOMMER, M.D.

**Diphtheritic Cystitis and Urethritis Following Prostatectomy** GEORGE WOLNOMER. *Br. J. Urol.*, 1945, 20, 18.

The author describes a case of diphtheritic wound infection which occurred after prostatectomy and

affected the suprapubic wound, the bladder and the anterior urethra

Severe complications appeared as a direct or indirect consequence of the infection i.e. congestive cardiac failure due to toxic myocarditis and peripheral neuritis affecting the peroneal nerve. The occurrence of a urethral stricture must also be the result of the infection

The source of the organisms was undoubtedly the patient himself as he was found to be a faecal carrier of diphtheria bacilli. It seems likely that the organisms were transmitted through the patient's fingers to the urethra and from there to the bladder and suprapubic wound. Alternatively it is possible that the postoperative state of the bladder wall acted as a place of least resistance where blood borne pathogenic organisms could readily settle.

Serum therapy was tried in this case but did not meet with obvious success. This disappointing result agrees with the experience of others who used it in instances of wound diphtheria

JOHN A. LOFF, M.D.

Observations on Hypospadias. A. M. LOUGHRAN  
*Brit. J. Plast. Surg.*, 1948, 1, 147

Loughran reports late results of Ombredanne's hypospadias operation in 29 patients who could be followed up completely. He believes that the basic cause of hypospadias is likely to be some discord in the endocrine symphony of mother and child; it is both familial and hereditary. In his series the condition was encountered in father and child and in several sets of siblings. The degree of hypospadias also seems to be hereditary and familial. In the differential diagnosis adrenal virilism in the female and a congenitally short anterior urethra must be excluded. The former can be diagnosed if a vagina is present, but when the labia are fused and the clitoris is hypertrophied, an error can be made. Since no biological assay is available laparotomy and biopsy of the genital glands must be performed in doubtful cases. In a congenitally short anterior urethra in spite of the penis bowing and the redundant foreskin the prepuce is complete and the urinary meatus is at the tip of the glans.

In some hypospadiac patients there is considerable bowing in some there is none, and in the third variety the penis appears to be foreshortened because of the ventral penoscrotal webbing, if the web is not corrected the penis will become bowed as growth proceeds. Loughran believes that early operation should be performed before psychical trauma has occurred. Operation should accomplish correction of the penile curvature, a satisfactory stream in the standing posture, the absence of stricture, absence of urethral hairs and a satisfactory cosmetic appearance.

Of Loughran's 59 patients only 43 could be traced and in only 29 was follow-up complete. A good cosmetic result was recorded in 24. The meatus was at the tip in 25 and somewhere on the glans in 3. A good stream in the standing position was claimed by 24.

Fistula on the glans was present in 3. No hairs were observed in any cases. Enuresis was present to a later age in 34 per cent. Therefore a good result could be claimed in 24 and a fair result in 4; failure occurred in 1 case (among 75 operations performed on the 29 patients).

Ombredanne's operation is the operation of choice because the late results are good, the operation is simple to perform, no special instruments are required, deflection of the urinary stream is unnecessary and the penoscrotal web if present is incidentally destroyed in the raising of the pouch.

DAVID ROXBOROUGH, M.D.

# MISCELLANEOUS

Urea Clearance by Perfusion of the Intact Small Intestine. N. S. R. MALUF. *J. Urol.*, Balt., 1948, 60: 307

A method is described for perfusing practically the entire small intestine in man by means of a 3 way modified Miller Abbott tube. Most of the perfusion fluid is sucked back through one of the conduits into a container.

The perfusing liquid is a per cent anhydrous diacid sulfate which is only slightly hypertonic to plasma.

When the rate of inflow is between 25 and 30 c.c. per minute the concentration of urea in the outflow fluid is approximately equal to that in the plasma (It is advisable to put a little xylene in the recipient bottle to inhibit bacterial splitting of the urea). The urea clearance is thus roughly equal to the number of cubic centimeters per minute.

The amount of urea removed in unit time varies with the rate of perfusion and with the concentration of urea in the plasma. The amount of urea that can be extracted in unit time is equal to or greater than that extracted by other methods of diffusion, peritoneal irrigation and external dialysis ('artificial kidney').

The merits of this procedure as compared with those of peritoneal irrigation and external dialysis are discussed.

JOHN A. LOFF, M.D.

The Significance of Calcareous Tuberculous Glands in the Abdomen in Relation to the Urinary Tract. JAMES A. ROSS. *Brit. J. Urol.*, 1948, 20, 100

The author reviews a total of 5,000 case reports to ascertain the frequency and symptomatology of calcified glands in relation to the urinary tract.

Calcified glands were found in 608 patients i.e. in from 12 to 16 per cent of cases. In only 25 (0.5 per cent), or 1 in 200, could the glands be considered as a possible cause of symptoms and in only 10 (0.2 per cent) or 1 in 500, could the calcified glands be considered to have effects on the urinary system.

These effects consisted of a deviation of the ureter a bend or kink in the neighborhood of the glands with or without slight dilatation of the ureter or pelvis above it, and with or without symptoms. The symptoms consisted of slight pain in the respective side or

slight renal colic. No stenosis of the ureter was found and a case reviewed 8 years after localized deviation and dilatation of the ureter in the neighborhood of calcareous glands had been reported showed the ureter to be practically normal.

Unless a definite kink or deviation of the ureter can be shown the discovery of calcareous glands in the course of an investigation can be dismissed as being of very little significance.

JOHN A. LOAF, M.D.

True Abacterial Pyuria. GUNTA J. SEON. *Ida. J. Med.* 943, 97-98.

Jansson reports a series of true abacterial pyuria which were exhaustively studied. A diagnosis of urinary tract tuberculosis was ruled out through the absolute failure to demonstrate tubercle bacilli and the spontaneous regression of pyelographic changes.

The author states that the diagnosis of bacterial pyuria is possible only after the exclusion of tuberculosis. The majority of cases described have occurred in men. Possible biological factors are (1) toxins from a focus (2) coccal infections and (3) virus infections. Histologically the lesions in true abacterial pyuria are very superficial and are classified as pyelitis and urethritis follicularis. The lesions do not penetrate lower than into the submucosa. Clinically a cystitis is present with frequency urgency pain in the region of the bladder and occasional hematuria there is no fever nor is there any general disturbance of health. Some cases subside spontaneously. The urine contains numerous leucocytes but no bacteria are demonstrable on smear, culture or guinea pig inoculation. No anatomical changes of the external or internal genitalia are present. Renal function is unimpaired. The cystoscopic picture of abacterial pyuria shows hemorrhagic cystitis edema, and fibrin deposits. This is

contrary to the picture of tuberculosis in which specific lesions lie next to areas of normal mucous membrane. Kidney urines contain leucocytes and the capacity of the bladder is reduced. In the author's cases, pyelographic changes suggestive of tuberculosis were present.

Cases of dilatation of the pelvis and ureter in abacterial pyuria are reported in the literature. In the author's patients, striking improvement as observed following the administration of neomycin, the pyuria subsided and the urographic abnormalities disappeared.

DAVID ROSENBLUM, M.D.

Cancer of the Urachus (Cáncer del uraco). RICARDO ESCOBAR. *Bol. Soc. Cir. Rosario*, 943, 5-7.

The world literature reveals only 154 cases of urachus affections. Because of the relationship of this organ to the bladder, the presenting symptoms are those of vesical complaints and early treatment is usually directed toward the bladder.

Two cases are presented in this article. The first was that of a 64 year old man who complained of pain in the hypogastrium and polyuria. Palpation revealed a discrete tumor below the umbilicus giving the impression of probable metastatic growth. Cystoscopy disclosed nothing worthy of note and endoscopic biopsy of the tumor showed cancer of the urachus, the histopathologic diagnosis being cylindrical papillary epithelioma with origin in the epithelial rests of the urachus.

The second case was discovered incidentally during the course of an operation for removal of an enlarged prostate. The tumor was of the nature of a small partially calcified cyst adhering to the bladder. The histopathologic diagnosis revealed a cyst of the urachus, the epithelium covering being of immature bladder cells.

STEPHEN A. ZIEGLER, M.D.



# SURGERY OF THE BONES, JOINTS, MUSCLES, TENDONS

## CONDITIONS OF THE BONES, JOINTS, MUSCLES, TENDONS ETC

**Hyperplastic Callus Formation With or Without Evidence of a Fracture, in Osteogenesis Imperfecta** Sir H. A. THOMAS FAIRBANK. *Brit. J. Surg.* 1943 36 1

The author presents 8 interesting cases of hyperplastic callus formation 7 of which are definitely osteogenesis imperfecta. Each case shows a abnormal calcification of local callus sometimes without recognizable recent fracture. Some of the cases show markedly excessive formation of ossified callus enveloping the shaft to an unusual extent, with result of permanent enlargement of the affected bone. Some cases showed the formation of bony excrescences on the shafts of the long bones particularly on the interosseous borders and without the faintest sign of antecedent fractures.

In 2 of these cases the mass of bone resembled neoplasm, and biopsy and microscopic examination were necessary to make the diagnosis. The tissue in these cases was of a fibromucoid cartilaginous structure (chondroid).

The trabeculation of the larger bony masses was very coarse and there was no tendency to reabsorption or remodeling of the bone such as would be seen in cases of scurvy or other types of subperiosteal hemorrhage with ossification.

No attempt is made to show the cause of this abnormal bone but the author believes that the only exciting cause that can be assigned to these cases is trauma.

NEWTON C. MEAD M.D.

**Bone Lesions in Eosinophilic Granuloma, Hand-Schneller-Christian Disease, and Letterer-Siwe Disease.** TOMACIO FORRELL. *J. Bone Surg.* 1943 30-A: 811

Eosinophilic granuloma Hand-Schneller-Christian disease and Letterer-Siwe disease have a number of clinical, roentgenological and histological characteristics in common eosinophilic granuloma being a more localized lesion in bone while the granuloma Letterer-Siwe disease are more widely spread and may affect many organs.

Eight cases are presented. The first case was that of a 5 year old white girl with eosinophilic granuloma of the skull. Excision of the tumor resulted in a very cellular tissue containing large cells with granular protoplasm and a number of eosinophils.

The second case was that of a 42 year old male with injury to his left leg. On examination a slight, nontender tumor was found on the lateral aspect of the left mid thigh. The knee appeared normal. Biopsy revealed relatively avascular and granular tissue with large mononuclear cells eosino-

phils large giant cells and fibroblasts. Roentgen therapy was given without any success. A mid thigh amputation was then performed. The histological section did not show any convincing evidence of malignancy. There was no evidence of metastases 5 years after surgery. The remaining cases suggested from their course and clinical findings resemblance to osteomyelitis tuberculosis and endocrine disturbances.

The pathological findings however suggest that all 3 conditions are manifestations of the same process. A large liver and spleen, moderate enlargement of all palpable lymph nodes anemia leucocytosis and extensive infiltration of both lungs suggest Letterer-Siwe disease. Diabetes insipidus increased blood cholesterol and blood lipids are more characteristic of Hand-Schneller-Christian disease. The histological picture however is practically the same. It is often difficult to classify properly the symptoms presented by a patient affected with lipogranuloma in any one of these conditions.

GEORGE I. REIMS, M.D.

**Solitary Plasmocytoma of Bone with Renal Changes** GEORGE LUMA. *Brit. J. Surg.* 1943 36 16.

A case of solitary plasmocytoma of the sacrum is reported along with a brief review of the literature. The principal interest of the case is the association of fatal renal tubular blockage of the type found in multiple myelomatosis. Solitary plasmocytomas have not usually been associated with either the finding of Bence Jones proteins in the urine or renal damage and have not been thought of as the same disease process as multiple myeloma, but the findings in this case and in one other case (reported elsewhere and cited by this author) suggest that this is a single focus of a disease usually presenting multifocal form.

The author suggests that the appearance of Bence Jones protein in the urine is a result of actual tumor volume and is due to the amount of bone marrow involved. In this case the tumor was large replacing the entire sacrum.

A complete report of biopsy findings is presented. NEWTON C. MEAD M.D.

**Ruptured Quadriceps.** ERIC I. LLOYD. *Brit. J. Surg.* 1943, 36 94.

Rupture of the quadriceps femoris almost always occurs in heavy elderly men following indirect violence. It is often wrongly diagnosed and there is rather a high risk of pulmonary embolism.

The diagnosis would be easy if the condition were always remembered as a possibility. Inability to extend the knee associated with a palpable depression in the surface of the extensor tendon, can only be due to a ruptured quadriceps but the diagnosis is often missed owing to lack of familiarity with the condition. Three cases are cited as examples. An

anteroposterior radiograph of both knees on one film will demonstrate that the patella on the ruptured side is quite obviously lower than the patella on the normal side caused by loss of postural tone.

Operative treatment offers the only chance of regaining normal power. Twenty-four hours before the operation a 3/4 inch zinc-platin bandage is fixed to the foot, from the web of the toes to a point 2 inches above the ankle joint, and the upper inch of this is then covered by a cuff of felt 4 inches wide which is stitched or stuck around the limb. Five hundred thousand units of penicillin are given intramuscularly in one dose on the day before operation and repeated the next day.

A generous curved incision, concave proximally, exposes the frayed torn ends of the tendon and surrounding blood clot. The synovial membrane may be sutured at this stage if bruising and edema of the tissues do not make it too difficult. Sufficient tendon occasionally remains attached to the patella to make direct suture possible, but it is much more common to have to drill the bone and to proceed as follows: A suture of No. 1 kangaroo tendon is inserted through the tendon and is then passed through a single transverse drill hole in the upper third of the patella. This suture re-establishes continuity of the rectus femoris with the patella, but it must be supplemented by a series of interrupted chromic catgut sutures both centrally and on either side before the wound is closed without drainage.

A strong plaster slab is now placed along the back of the limb so that it rests on the felt strip just above the ankle and upon a second which encircles the upper one third of the thigh. The plaster slab is held to the limb by a few turns of plaster bandage above and below the field of operation, and an ample dressing is firmly bandaged over the wound so that it can later be removed without disturbing the plaster which is used to hold the knee joint in full extension.

The patient is returned to bed with the injured limb on a pillow beneath a cradle. As soon as he has regained consciousness he sits up and is provided with a back-rest and overhead hand-hold. He is asked to move his ankle and toes through a full range of movement for a few minutes every hour. These patients are frequently over 70 and there is a real risk of pulmonary embolism if they are allowed immobility.

In 4 or 5 days the patient may begin static exercises to the quadriceps and he is gradually coaxed into moving his plastered leg and even lifting it off the bed. The stitches are removed in 10 days and the plaster completed in such a way that static contractions of the patella remain possible. The patient should be out of bed and walking with a stick next day and soon afterwards be walking with full weight bearing. The plaster is removed 6 weeks after the operation and active and passive movements with radiant heat are given to the knee joint.

In recent examples the results of operative treatment are concluded to be excellent and in patients

operated upon within 3 months of the injury the results have been fairly satisfactory.

RUDOLPH S. RUSCH, M.D.

**An Unusual Localization of a Brodie's Abscess in Bone; the Distal Diaphyseal Epiphyseal of the Radius (Localizzazione rare dell' ascesso osseo di Brodie: la diafiso-epifisi d'iale del radio).** V. DIAMONDO LAURICELLA. *Riforma med.*, 948, 6 464.

The author reports a case of Brodie's abscess in a man 24 years of age who was first seen January 15, 1948. The author believes the abscess to be unusual in view of the fact that it occurred at the diaphyseal-epiphyseal junction of the radius.

The patient injured his wrist during a pugilistic encounter and very soon thereafter developed a tumefaction of the area. This became red and was finally incised with extrusion of a small quantity of pus. The wound did not heal, and from time to time more purulent material exuded.

X-ray films revealed a cystic area the size of a bean in the distal lateral portion of the radius in which the bone trabeculations had been destroyed.

At operation this area was found to contain a thick purulent material, with some spicules of dead bone.

Culture of this material revealed a pure culture of the hemolytic streptococcus. The postoperative course was uneventful.

The author also adds a good bibliographical review of the subject, presenting the various phases of the controversial etiology.

CARLO SCUDERI, M.D.

**The Diagnosis of Traumatic Lesions of the Meniscus (Diagnostica das lesões traumáticas dos meniscos)** JOÃO BOTTELEIRO, *Gaz. med. Portuguesa*, 948, 501.

The diagnosis of traumatic lesions of the meniscus must be based on the history of the accident, the objective and roentgen examination of the patient, and arthrocentesis. A good history is of fundamental importance. It reveals nearly always an initial injury which in from 50 to 60 per cent of the cases occurs during some sport, principally football, and in from 40 to 50 per cent during work or the activities of daily life.

The mechanism of these lesions is always a movement of flexion or extension superimposed on an internal or external rotation of the knee. In general, it is the internal rotation of the femur on the semi-flexed and fixed tibia which most frequently causes rupture of the fibrocartilage, especially on the medial side, but the same mechanism may also produce a lesion of the lateral meniscus in its posterior half. Much less frequent is the external rotation of the femur which then damages particularly the lateral fibrocartilage. From the beginning there may or may not be a block. Pain, functional disability and hyarthrosis constitute the symptomatology of the initial accident. The meniscal lesion is characterized by recurrence of the painful episode alternating with

## SURGERY OF THE BONES, JOINTS, MUSCLES, TENDONS, ETC.

**Treatment of Pseudarthrosis by Simple Onlay Bone Graft Without Removal of Callus.** DALLAS B  
PREMIER. *J. internat. chir. Bruxelles* 1948, 8, 713

It is widely believed that in pseudarthrosis the callus is so extensively altered that it cannot be made to ossify, and that in order to obtain bony union the false union must be broken down the callus removed and the fragments fixed, preferably by a bony transplant held rigidly by screws or wires.

A less traumatizing and more biological operation is available. In a series of 80 cases it has been found that in cases in which the fragments are in acceptable position the fracture nearly always unites if a strong bone graft is applied to a denuded and leveled side of the fragments across the fracture line and held in place only by the soft parts sutured tightly over it leaving the callus which holds the ends together.

A longitudinal incision is made at the level of the fracture and the periosteum is separated from the side of the fragments sufficiently to create a bed for the bone graft. If the exposed surface is irregular, enough of the protruding bone and callus are chiseled away to create a level surface for complete contact with the graft. A strong whole thickness graft is cut usually from the tibia but sometimes from the ilium and applied to the exposed side of the fragments across the fracture line. In some instances two smaller whole thickness grafts are used especially if the fracture is near the end of the bone. Cancellous bone grafts are sometimes applied on either side of the cortical graft at the fracture line. In fractures of the large bones the length of the graft varies from 7 to 12 cm. for the midportion of the shaft and from 3 to 6 cm. for the ends of the shaft. The periosteum and soft parts are sutured tightly over the graft and then held it firmly in place. The remaining attached periosteum and the callus hold the ends of the fragments together. Neither fragments nor grafts become displaced. In some cases the intermediary callus has been extensively curetted out but usually it has been left intact, and the result has been the same in either case. After closure the extremity is immobilized in a plaster dressing for 2 to 3 months.

During this period the graft becomes united to the shaft by callus thrown out by both structures. Because the graft is not firmly fixed by screws the contraction of the muscles produces axial coaptation of the fragment ends and stimulates osteogenesis. Movement at the fracture line is gradually eliminated as union proceeds between the graft and the fragments. Bony union is usually solid in 2 to 3 months depending on the bone involved and the nature of the fracture. Further immobilization is rarely necessary.

If the displacement is great this operation is not used instead the fracture is reduced and the fragments are fixed by a strong onlay graft anchored with metal screws.

periods of recovery and always caused by a torsion similar to that of the initial accident. In these recurrences, block or sudden claudication of the knee may predominate, but pain and hydrarthrosis are always present.

Block exists in 50 per cent of the cases and occurs in semiflexion. Sudden arrest of the leg which is being extended can be caused only when a fragment of meniscus is interposed between the femur and tibia at a point anterior to the coronal plane of the joint. Thus only those meniscal lesions which extend beyond the plane of the lateral ligaments particularly the longitudinal lesions which extend in front of this plane, cause block.

Sudden claudication of the knee may be regarded as an equivalent of block. It is due to a lesion of the posterior half of the meniscus especially of the posterior horn. There is no typical block in these cases. The patient has the feeling of having an unstable knee, particularly when going down stairs.

Hydrarthrosis accompanies the meniscal accident and is proportionate to the amount of block or of its equivalent. It is a sign that the ligaments, capsule, or synovial membrane have been damaged but it is more a sign of sprain of the knee than of meniscal lesion.

The typical pain of a meniscal lesion usually extends quite forward beyond the plane of the ligaments and in the lateral interarticular line. Lesions of the posterior horn cause pain that is vague and often within the joint without typical localization. The pain may be present only at the time of the accident or it may be vague and permanent, like grinding.

Objective examination reveals increase in volume of the knee and appreciable atrophy of the thigh muscles particularly of the quadriceps. The increase in volume of the knee is principally due to hydrarthrosis. However there is often no hydrarthrosis and the swelling is more apparent than real being due to the contrast between an atrophied thigh and a more or less normal knee. There is always some degree of atrophy and atony of the quadriceps, the limitation of movements, especially during flexion, is encountered with some frequency and is a sign of a lesion of the posterior horn.

Pain in the joint line is reproduced by certain positions of the tibia in relation to the femur and various authors have described different ways to induce it. This has introduced a series of signs which include those of Boehler, Rocher, Steinmann, Brauer, Payr, Graham, Apley, Turner and McMurray. Routine roentgen examination has no practical importance for the diagnosis of meniscal lesions. Exceptionally calcification of the fibrocartilages may afford some information. The value of roentgen examination lies in the demonstration of lesions of the bones and to the ligaments when they are made in forced varus or valgus positions. Arthropneumography is discussed in another article.

RICHARD KENNEL, M.D.

If there has been previous infection of the fracture the graft should be introduced through an incision away from the healed scar and applied to the opposite side of the fragments. Because of the lesser danger of infection, this operation may safely be done weeks or months earlier than one in which the approach is through the old field of infection and the pseudarthrosis is broken down.

The operation may be quickly performed with little damage of tissues, little blood loss, a low incidence of shock and wound infection, and without the use of plates, wires and screws.

RUDOLPH S. REICH, M.D.

Rupture of the Biceps Brachii, with Report of a Case of Bilateral Rupture of the Long Tendon  
H. K. CHRISTIE. *Austral N Zealand J Surg* 1948, 8:37

The author reports an unusual case of bilateral rupture of the long tendon of the biceps brachii, occurring in the left biceps in 1945 while lifting a log, and in the right biceps in 1946 while lifting a heavy case. The rupture in the right biceps was operated upon immediately the free end of the tendon being inserted into the pectoralis major tendon, looped around and sutured to itself, the forearm being held in full flexion during the procedure and for a period of 3 weeks after operation. Passive movements were started after 3 weeks, and by 6 weeks full range of elbow motion was restored. The left biceps was operated upon 4 months later (about 18 months after occurrence of the injury). The result was excellent.

The typical syndrome of traumatic rupture of the biceps includes a sudden snap when lifting, associated with acute pain and loss of power. Local swelling and synovial effusion occur. Most characteristic is the egg-shaped tumor caused by the disinserted muscle belly. If the long head ruptures, the muscle belly descends toward the elbow, and if the common tendon of insertion is ruptured the muscle belly ascends. A tear in the belly of the muscle can be felt as a gap or depression. These signs are increased by attempts at muscular contraction.

DANIEL H. LEVINTHAL, M.D.

The Treatment of Severe Scoliosis. Resection of the Spinal Column. (Tratamiento de las escoliosis graves. La resección de la columna). MARCELO J. FITTA, LUIS A. GONZÁLEZ, and ANTON BRACCO. *Bol. Acad. argent. cir* 1948, 32:566.

For the correction of severe forms of scoliosis, especially those of the lumbar or thoracolumbar region, the authors recommend resection of the spinal column. The method was originally developed by Volkmann. The operation is performed under cyclopropane-oxygen anesthesia. Morphine, barbiturate and atropin are administered preoperatively and a blood transfusion is given during the operation. Surgery is performed with the patient lying on his side, the convexity of the spine pointing upward. If the curvature is low an incision resembling that for nephrectomy is employed. The incision extends

from the corresponding anterior superior iliac spine to the costovertebral articulations of the eleventh and twelfth ribs and from there 3 or 4 cm. upward along the lateral border of the long spinal muscles. It may be necessary to resect the eleventh and twelfth ribs. As a rule, 5 vertebral bodies are exposed. The corresponding intervertebral discs and wedge-shaped portions of the vertebrae are removed. Care must be taken not to injure the kidney. Hibbs technique, utilizing portions of the tibia, is employed to stabilize the spine. A special hinged corset is employed for further correction of the scoliotic curve.

A follow-up study of 2 children operated upon more than 1 year prior to this report showed excellent results: one of them was 12 and the other 13 years of age.  
JOSEPH K. NARAT, M.D.

Factors Favoring Successful Transmetatarsal Amputation in Diabetes. HOWARD F. ROOT. *N. England J. M.* 1948, 239:453.

Although the emergency character of infectious or early gangrenous lesions of the toes and feet of diabetic patients has long been recognized by most physicians, a new aspect of this problem is presented by the demonstration that in many diabetic patients a useful and serviceable foot can be preserved through the proper use of the transmetatarsal amputation.

One hundred and thirty-three transmetatarsal amputations were carried out on 122 different diabetic patients in the New England Deaconess Hospital, Boston, during the period between 1944 and September 1947. In 22 cases, failure to heal is recorded but in 3 of these thigh amputation was not necessary.

Gangrene of one or more toes was present in 78 cases, and in these cases the pathological report also mentioned osteomyelitis. In another 19 cases osteomyelitis alone was recorded. In 36 cases the lesions were described as chronic ulcerations in the feet, with defective circulation or a neurotrophic disturbance of sensation. In all cases some type of trauma had been present. The commonest lesion was an infected callus with extension into the bone or joint. The invasive lesions numbered 62 and the localized lesions, 7. Success was not dependent upon the presence or the lack of the active invasive type of infection.

This group of patients was composed of mild cases of diabetes of long duration in patients who had formerly been extremely obese. It is evident that serious foot lesions in mild diabetic patients depend in part upon an antecedent obesity and in part upon metabolic changes associated with great losses of weight due in a large measure to relatively uncontrolled diabetes.

The condition of the circulation, both general and local, is in many cases a chief factor in determining operative success. Although the patients in both groups showed slightly high blood pressures the series as a whole was characterized by moderate

the dorsal aspect of the articular surface of the distal head of the metacarpal. Alignment is corrected and by passing a second wire through the distal head of the metacarpal into the adjacent metacarpal. Both pins are cut short to allow them to be subcutaneous. A pressure dressing and plaster splint are applied. Richard J. Bennett Jr. M.D.

**End Results in 77 Consecutive Fresh Fractures of the Neck of the Femur** JOHN T. R. GALLAGHER, M.D. *Sur.* 1948, 76:55

The author reviews 77 consecutive cases of fresh fractures of the neck of the femur in patients treated at the Jackson Clinic during the years 1936 to 1946 inclusive. Fifty nine per cent of these patients were between 70 and 90 years of age and 88 per cent were females. Twenty-two, or approximately 30 per cent of the patients had impacted fractures. These patients were treated by Russell's traction (4 to 5 pounds) or then a wheel chair was used, followed by partial weight bearing with crutches and full weight bearing at from 3 to 6 months. No disrupted impacted fractures or other complications developed during hospitalization. Excellent nursing care was available. All of these patients made uneventful recoveries except one who was transferred to internal medicine and subsequently developed a deep ulcer at the fracture site and died of the fact that the impaction was broken up by the insertion of the nail and was not corrected adequately. Nine of the patients with functional results with full weight bearing placed fractures (as compared to the fracture and bony union with the Smith-Petersen nail under spinal anesthesia. The 3 patients who were not operated upon died within a week from other causes. One case year old female with pernicious anemia who died 7 years after operation with a true operative mortality of 100 per cent. The overall mortality in the 9 years postoperatively fractures was from 22 to 40 per cent.

The primary generally added to were (1) anteroposterior and lateral x-ray examinations on patients in a condition with suppurative (3) evaluation of palmar reduction with the use of a modified leadbetter technique (5) lateral traction for 1 week (8) early ambulation and discharge from the hospital on crutches in 3 weeks (9) discarded of convalescence at 3 months (10) follow-up roentgenograms at 3 years. These patients seemed to do better initially than some of those with impacted fractures. Their mortality

fall during rest and the drop was greater in the successful group than in the failures. The local hypertension of the systolic type which naturally occurred in which healing proceeded successfully in spite of some other factor must be assumed. Cultures were made from the open lesions in 92 cases. Staphylococcus aureus in combination with other organisms is at present the most frequent wound. As yet no culture information is available as to whether the organisms are derived from outside sources or whether they have been carried to the lesion from within the patient's own body. The impression is that they gain entrance into the tissue through injury and a break in the skin and that the poor local resistance of the diabetic tissue enables the organisms to invade muscle soft tissue and, finally, bone and joint spaces.

In 24 of the successful cases various degrees of subluxation of the foot or even of the lower leg were present. These feet healed readily after surgery and remained healed so long as the patient was in bed or spending only a short time on the feet. Continued use of the feet in walking resulted in no later in the pressure areas ulcerations and infection and the resistance to infection in this group of patients seems even lower than that in the group as a whole.

A follow up summary to April 1948 reveals that results have steadily improved since 1944 owing to selection of patients and the introduction of chemotherapy and penicillin. Rudolph S. Kiser, M.D.

### REACTURES AND DISLOCATIONS

**Treatment of Dislocation of Metacarpal Phalanx** CARROLL J. VANDER, M.D. *Sur.* 1948, 76:344

Deformity may be prevented by proper treatment at the time of primary injury to the shaft of the metacarpal. Corrective osteotomy and capsulotomy are presented which have proved satisfactory in a small series of cases. A 2 per cent nonunion block and the rate of the used.

Undistinct incision is made through the extensor comma tendon with retraction of each half to expose the dorsal ligaments and collateral ligaments. The dorsal joint capsule is made if necessary. A V-shaped incision is performed on the metacarpal at the site of nonunion. Correction of any loss and rotation is carried out. A fine Kirschner wire is passed through

was high their hospital stay was shortened and the gradual burden was lightened. In this group, however there were 6 cases of nonunion (11.1%) and 25 (39.7%) showed ankyrosis and 35 (55.3%) developed degenerative arthritic changes of the cervical vertebrae. Every case of ankyrosis or the cervical vertebrae and the shoulder was accompanied by degenerative arthritic changes of a moderate to severe degree. In 18 cases the nails were removed at various intervals after 1 year when arthritic changes had occurred. When one nail was found to be bent the author casted another similar nail and made the interesting observation that the incidence of arthritic changes was increased in plaster cast of the nail at operation.

The author concludes that the incidence of arthritic changes and degenerative arthritic changes in plaster cast of the nail at operation will be considered in plaster cast of the nail at operation. The fact might be required with the blades fast. The fact might be required with the blades fast. The fact might be required with the blades fast.

Four principles of treatment were followed (1) thorough investigation of the wound bone (2) radical debridement after adequate preoperative preparation (3) the use of streptomycin and penicillin before and after surgery and (4) meticulous wound care to avoid contamination.

The *Strepococcus vulgaris* and hemolytic *Staphylococcus aureus* as the most common organisms found in the bacteria were equivalent to 6 microorganisms or less of streptomycin per cubic centimeter of media.

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The greatest difficulty has been encountered in the treatment of tuberculous of the ankle and wrist. The treatment of tuberculous of the ankle and wrist has been encountered in the treatment of tuberculous of the ankle and wrist.

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then applied. All distortions should be treated like reduced luxations but with shorter immobilization. In intra articular fractures, the bone and the cartilage must be replaced in their original position, the cartilage especially must be carefully reduced because it heals only with connective tissue, which may become an irritative element for the opposite articular surface. Muscular atrophy is combated by active mobilization and massage is used only after the periarticular inflammatory irritation has disappeared. The duration of immobilization will depend on the nature and gravity of the lesion: even prolonged immobilization in correct position does not present much danger of ankylosis. Attention must also be paid to the posttraumatic reactions of the tendinous insertions and of the apophyses. Absolute rest may be completed by the use of analgesics and substances capable of modifying and regulating the local vasculature. Marti prefers infiltrations of 1 per cent novocain to which he adds acetylcholine because of its remarkable vasodilator effect.

The medicolegal problems arising from the articular disorders are discussed on the basis of the Swiss legislation concerning compulsory insurance against accidents.

RICHARD KNEEL, M.D.

**The Occurrence and Management of Reflex Sympathetic Dystrophy (Causalgia of the Extremities)**  
JAMES W. TUCKER, *J. Bone Surg.* 94B, 50-4, 1952.

This study is based on experience with 31 cases. The most prominent symptom of causalgia is a continuous burning pain in the extremities. There

may be signs of vasoconstriction or vasodilatation. The obvious signs are coldness, increased sweating, pallor or cyanosis of the skin, and swelling of the hand or foot. The advanced cases may resemble rheumatoid arthritis.

The x-ray examination shows either spotty or generalized decalcification. The pain may appear right after the injury or it may begin weeks or even months after the injury. Nerve injuries injuries to the blood vessels or crush injuries are known to cause causalgia very frequently. It was shown that the pain increases in both degree and extent and is liable to change the entire personality of the patient. The treatment consists of injections of procaine into the trigger points or into the appropriate segments of the sympathetic chain, i.e., the stellate ganglion, or the second and third thoracic ganglia or a paravertebral sympathetic block may be done. A simple negative peripheral block should never be accepted as a true diagnostic sign because of the possibility that the ganglion was missed. Sympathectomy was done in patients who had temporary relief from procaine blocks.

The best results following the operation were obtained in the younger age group. Good or excellent results were obtained in approximately two-thirds of the patients operated on. It was found that patients who had had causalgia for a long time responded less favorably to this procedure than those whose symptoms had been of shorter duration. Etamon chloride was used instead of procaine with satisfactory results.

GEORGE L. REISS, M.D.



# SURGERY OF THE BLOOD AND LYMPH SYSTEMS

## BLOOD VESSELS

**Thromboangitis Obliterans.** J B KIMMONT  
*Lancet* Lond. 1948, 2 717

Seventy-seven patients with thromboangitis obliterans were studied. Intermittent claudication superimposed vasospastic attacks and ulcers seemed to improve after sympathectomy. Prophylactic sympathectomy in some early cases of unilateral Buerger's disease did not give complete protection although it possibly delayed the onset of symptoms. The effects of sympathectomy and the prognosis are best when the small vessels are the first to be involved.

ROBERT A. NARATOFF M D

**Traumatic Rupture of Normal Aorta.** LARS THORÉN  
*Upsala läk. fören. förh.* 1948, 5 207

As compared to rupture of pathologically involved aortas traumatic rupture in a normal aorta is considered rather unusual. After a brief survey of those pathological conditions which usually cause rupture 4 cases of traumatic rupture in a normal aorta are described. The usual sites of rupture are discussed as are the various theories concerning the pathogenesis of these lesions. An estimate based on the literature reveals that from two-thirds to three-fourths of all ruptures occur in the ascending aorta. Apart from direct laceration of the wall, the mechanical tension on the wall plus an intravascular increase in pressure. The theory that a normal aorta may rupture merely as a result of an increase in blood pressure following violent strain "appears to be unlikely. Uncomplicated partial ruptures offer the most favorable prognosis but if a dissecting aneurysm develops from a partial rupture the prognosis becomes considerably less favorable.

The treatment of these conditions is discussed and it is noted that the clinical picture of partial rupture with dissecting aneurysm may resemble an acute condition of the abdomen.

ROBERT A. NARATOFF M D

**Saddle Embolus of the Aorta.** JOHN L. KEZLEY ANN  
*Su J.* 1948 128 257

A 52 year old woman recovering from her second episode of cardiac decompensation for which she had been receiving digitalis and who was known to be suffering from auricular fibrillation displayed vague rapid onset of coldness pain and paralysis of both lower extremities accompanied by pain in the lower abdomen and sacral region. Pulsations of the aorta were absent beyond the sacral promontory save for weak pulsations in the region of the left femoral artery. A diagnosis of saddle embolus was made and a transperitoneal embolectomy was performed within 6 hours of embolism.

Through a 2 cm. incision in the aorta at its junction with the right common iliac artery the obstructing clot together with a 6 inch tail thrombus in the right iliac artery was removed and the arterial defect was closed with an everting running mattress stitch. The administration of 100 mgm of heparin was begun at this time. Operation required 115 minutes. Pulsations were immediately present in the peripheral vessels except for the left dorsalis pedis artery in which it was not detected until the fifth postoperative day. Adjunctive therapy consisted of procaine lumbar sympathectomy block on the first postoperative day, pontocaine spinal anesthesia on the second through the sixth days. Intermittent venous constriction and anticoagulant therapy. Dependent edema of the legs disappeared after 6 weeks. In the peroneal group of muscles mild weakness of the left leg persisted. Cardiac compensation has been maintained.

A discussion of the recognized etiologic factors together with diagnostic and therapeutic features follows the case report. The author states that embolectomy is the only lifesaving treatment for a patient with an aortic embolus. The choice of operative procedure—a direct attack upon the involved femoral artery or an indirect approach whereby the iliac or from below—is decided by the condition of the patient.

ALLAN D. CALLOW M D

**Accidental Intra Arterial Injection of Drugs.**  
*S M. Comm. Lancet* Lond., 1948 2 361 409

The present article is concerned with the tragedies following accidental intra arterial injection of some substances commonly employed in anesthesia, and such procedures as roentgenographic diagnosis and cholecystography. Additional instances of occasional catastrophes following improper injection of anesthetic amine quinine ethanalamine bumuth and Hartmann's solution are provided. Detailed case reports of 12 instances in which thiopentone (pentothal sodium) was injected intra-arterially and the clinical features pathologic lesions treatment and suggestions for prevention constitute the larger portion of the article.

Eight of the patients suffered the loss of some part of the extremity 3 made what appeared to be complete recoveries. 1 patient suffered disabling residual consisting of weakness and sensitivity to cold. The author estimates that a fair figure for the incidence of major thiopentone tragedies in his country is probably 1 case in 55 000 cases. He feels that such an accident can happen to anyone and is not a reflection upon the competency of the anesthetist. The variable anatomy of the arterial tree upon the front of the elbow upper arm and forearm is discussed and

a knowledge of these variations is held to be a *must* for the competent anesthetist.

The clinical features following intra arterial injection of thiopentone are listed as burning pain (the hand felt like a flaming branch), color changes in the hand and forearm which may progress to mottling, edema, muscle necrosis, changes in nerve function and in one case rapid loss of consciousness following the injection of a very small amount of thiopentone. The pathogenesis is largely dependent upon immediate thrombosis following damage to the intima by the highly irritant, strongly alkaline thiopentone. The circulation may be finally arrested by one or several of the following mechanisms: (1) arterial thrombosis, (2) arterial or distal arteriolar spasm, (3) extensive diffuse venous thrombosis, (4) extensive venous spasm, (5) mechanical blocking of the arterial tree due to protein flocculation or precipitation of the drug, and (6) arteriovenous communications enabling retrograde spilling-over of intravenous fluid into the arterial circuit.

The treatment of choice is held to be immediate arteriotomy with removal of the clot. Delayed surgery is of no help. Arteriotomy is held to be without advantage. Antispasmodics such as papaverine, aspirin, alcohol and others have not brought dramatic improvement. If surgery for the original lesion must be continued the author recommends general anesthesia, preferably cyclopropane deep enough to produce vasodilatation, but light enough to prevent a fall in blood pressure. Brachial block is advocated in preference to sympathetic block. Local measures such as protection by sterile wraps are advised in addition to maintenance of body warmth. Immersion of the opposite limb in warm baths (112 degrees F) elevation of the affected limb, and the generous use of morphine for the relief of pain.

Certain measures designed to aid the anesthetist in the prevention of such errors as accidental intra arterial injection of drugs are listed. These include checking the vessel to be injected for pulsation, selection of a vein beyond the antecubital fossa, injection of a trial amount and waiting for the development of pain, avoidance of a too tight venous tourniquet as well as hyperextension of the elbow and a detailed knowledge of the anatomical variations encountered about the elbow joint. Further experimental work on animals is held to be desirable.

ALLAN D. CALLOW, M.D.

Arterial Embolism. J. R. LEARMONTH. *Edinburgh Med J.* 1948, 55: 449.

The points of origin of arterial emboli are described. Three essential factors in the treatment of arterial embolism are: (1) the preservation of adequate blood volume, (2) the preservation of adequate general blood pressure, and (3) adequacy of the collateral circulation. The availability of the collateral channels depends upon the anatomic arrangement of the vessels at the involved site, arterial spasm, consecutive thrombosis, and the structural changes in the walls of the adjacent vessels.

First aid treatment of arterial embolism should include: (1) heparin, (2) placing the involved part at rest at a temperature from 15 to 20 degrees, (3) relief of pain, (4) induction of sleep to aid vasodilatation, and (5) if auralicular fibrillation is present digitals should be withheld unless there are signs of cardiac failure. The clinical types of arterial embolism are described and clinical examples are presented. If the patient is seen within 10 hours the author awaits the result of treatment with heparin. If this is of value unmistakable improvement will occur within about 3 hours. If there is an unprofitable interval, embolectomy is performed. The ultimate result will depend largely upon the exact site of obstruction and upon the architecture of the arterial tree in each particular case.

ROBERT A. NARATOFF, M.D.

Arteriotomy in Pains of Vascular Origin (*L'artériectomie dans les douleurs d'origine vasculaire*). J. AUSTRIE. *Rev. chir. Par.* 1948, 67: 293.

After a series of intravenous calcium injections the author's patient developed a syndrome first diagnosed as phlebitis, but which cleared up after 40 days of immobilization. A month later however the patient complained of attacks of severe pains in the cubital space which irradiated to the shoulder and forearm and exacerbated at night. A mass of hazelnut size could be palpated. There was hyperhidrosis of the palm and cyanosis of the fingertips.

As 5 novocain infiltrations of the stellar ganglion were unsuccessful the humeral artery was resected for a length of 6 cm. The operation was followed by prompt recovery and cessation of all pathological signs although the resected artery appeared normal histologically.

The author believes that the extra venous injection had caused an irritation of the adventitia and continuous spasms of the artery which were responsible for the cyanosis and hyperhidrosis as well as for the pains. No signs of an old phlebitis were found at the operation. The cubital veins were not thrombosed.

WERNER M. SOLMITS, M.D.

Results of 94 Arteriotomies (*Résultats de 94 artériectomies*). C. MENTHA. *Lyon chir.* 1948, 45: 1-4.

The author reports the results of 94 arteriotomies done on the service of Professor Leriche from March 1932 to January 1947. These operative procedures were done for senile and presenile arteritis in 80 patients. All of the patients were more than 45 years of age; 76 were males and 4 were females.

Although arteriography for the localization of arterial thrombi or the use of postoperative anti coagulant therapy was impossible during wartime the results were very favorable.

In 35 patients arteriotomy alone was done either unilaterally or bilaterally. In the 45 other patients this procedure was combined with unilateral or bilateral lumbar sympathectomy. The results were classified as excellent in 75 per cent and good in 26.25 per cent. Some improvement was obtained in

22.5 per cent. The results were slightly better in the patients who had arteriectomy combined with sympathectomy than in the patients who had arteriectomy alone. The patients were followed up for from 1 to 5 years.

The author concludes that arteriectomy either alone or combined with lumbar sympathectomy is the most efficient method for the treatment of chronic obliterative arteritis of the presenile and senile types.

EDWARD W. GIBBS, M.D.

### BLOOD TRANSFUSION

Chronic Leg Ulcer in Diseases of the Blood. BENJAMIN R. GRENDEL, *Blood*, 1948 3 1283

Chronic leg ulcers may occur as a complication of (1) sickle cell anemia (2) congenital (hereditary) hemolytic anemia (3) splenomegaly associated with Banti's syndrome (4) idiopathic thrombocytopenic purpura, (5) pernicious anemia (6) Gaucher's disease and (7) chronic hemolytic polycythemia.

He reports two cases. The first patient, a 52 year old white man presented a typical hemolytic anemia, the earliest symptom of which was the leg ulcer 27 years previously. This was successfully treated by skin grafting and splenomegaly. The second patient, a 60-year-old white man, at autopsy proved to have cirrhosis of the liver and congestive splenomegaly (Banti's syndrome).

The pathogenesis of the leg ulcers accompanying these diseases of the blood has not been satisfactorily explained. The common denominator would seem to be related to the spleen. It is suggested that the association of leg ulcer with these various diseases of the blood is related in an unknown manner to either splenomegaly or hyperfunction of the spleen (hyperplenism). LARRY J. KLEINBAUM, M.D.

Are Universal Donors Dangerous? (Les donneurs universels sont-ils dangereux?) M. P. ROBERT, P. H. BOWMAN, AND H. PERROT. *Presse med.* 1948 62 601

The authors discuss the advantages and disadvantages of using the universal donor in blood transfusions. They deemed it useful to reinvestigate the problem by studying the blood modifications taking place in the recipient at the site of the injection.

A series of experiments were conducted in which 50 c.c. of whole fresh blood from a Rh positive donor (with average or high agglutinin levels) were injected into a wrist vein of Type A recipients. The vein selected had no collateral drainage from the wrist to the elbow. Two trocars were placed in this vein at 10 cm. and 20 cm. proximal to the injection site and samples of blood were withdrawn at intervals during the transfusion. The transfusion was given rapidly and two samples were taken from each trocar after each 10 c.c. had been given or every 12 seconds. Sodium citrate was added to the first sample and the second was allowed to clot. In the citrated samples agglutination of the cells was looked for microscopically and in the clotted

samples the titers of the alpha and beta agglutinins were determined.

The authors were able to show that the titer of the foreign agglutinin alpha declined rapidly upon entering the recipient's vein. Very little was present at the 10 cm. trocar and practically none at the 20 cm. trocar. The titer of the agglutinin beta declined in a similar manner. These changes persisted throughout the transfusion. They explain the rapid disappearance of the agglutinins as follows:

1. Partial fixation in the vessel wall.
2. Partial though almost inconsequential loss through the combination with the recipient's red blood cells.
3. Absorption by the blood serum of the opposing agglutinins.

The authors proved the third explanation in the following manner:

The plasma from 20 c.c. of oxalated blood type A was mixed with an equal quantity of serum O (titer of alpha = 1/64; titer of beta = 1/64). Washed cells from the A blood and foreign B cells were then added. The foreign B cells controlled the beta agglutinins. There was a definite reduction of agglutinin alpha from 1/64 to 1/16 in 30 minutes and to 1/8 in an hour while the titer of the beta agglutinin did not vary.

The authors conclude that foreign agglutinins from the universal donor are rapidly neutralized at the transfusion site but the neutralization is accompanied by slight agglutination with resulting slight hemolysis which, most likely would be detrimental to weak anemic patients.

JOHN H. FLYNN, M.D.

### LYMPH GLANDS AND LYMPHATIC VESSELS

Surgical Management of Thoracic Duct Injuries. G. B. HODGE and HUNTER BRIDGES. *Surgery* 1948 24 805

Traumatic chylothorax is a rare but not uncommon condition which is due either to direct or indirect violence or to operative injury. Traumatic injury such as that due to crushing bullets or stab wounds on the chest and hyperextension of the vertebral column are often encountered.

Operative injury to the duct with chylothorax or chylothorax is a more frequent occurrence than one is led to believe from reports in the literature. The cervical portion of the duct is often injured in operations on the left side of the neck for tumor or enlarged lymph nodes. If unrecognized or not treated chylothorax will develop and if the pleura is opened chylothorax may occur. In injuries to the intrathoracic portion of the duct, chylothorax with its attendant high mortality will occur unless the injury is promptly recognized and treated.

Injuries to small tributaries or collaterals of the thoracic duct often become sealed without serious consequences. However injury to a large tributary with chylothorax may be present and not clear up for several days.



Fig. (Hodge and Bridges) Technique of implantation of the thoracic duct into the azygos vein.

The symptoms in chylothorax are those due to pressure and loss of chyle. The pressure symptoms may be relieved by frequent thoracentesis, but the loss of chyle if allowed to persist will result in inanition and death. With the loss of the constituents of chyle, marked deficiency state develops, characterized by weakness, hunger, intense thirst, emaciation, apathy, and death which is due to starvation. The lymphocyte and eosinophilic blood count are reduced.

The treatment of chylothorax has been medical, surgical, or combined. In the medical management a proper diet low in fats and rich in protein and vitamins, is given. Blood transfusions, plasma, glucose, saline solution, intra-venous infusion of aspirated chyle and thoracentesis have been employed. These supportive measures may maintain the patient's nutritional status until spontaneous or operative repair of the injury is carried out.

In operative injuries it is paramount that the injury be recognized at the time and appropriate treatment carried out. The authors have investigated a method of repair of a traumatized thoracic duct on dogs and satisfactory results were obtained in those cases in which the thoracic duct that was excised was ligated and in those cases in which the thoracic duct was implanted into the azygos vein. It was interesting to note that of the dogs in which a segment of the thoracic duct was excised and the divided ends left open, 4 recovered and 2 died. The autopsy on these animals revealed that closure of the open ends of the duct and collateral channels and lymphaticovenous anastomosis developed.

The authors concluded that in injuries of the lower part of the thoracic duct ligation is unsafe. If a primary repair of an injured or severed duct cannot be accomplished, then implantation of the thoracic duct into the azygos or other suitable vein should be carried out. This treatment is the most physiological if primary repair cannot be accomplished.

A case report was presented by the authors in which the thoracic duct was implanted into the azygos vein with complete recovery. The technique of the implantation into the azygos vein is illustrated in Figure 1.

JOHN E. KARLSEN, M.D.

# SURGICAL TECHNIQUE

## OPERATIVE SURGERY AND TECHNIQUE POSTOPERATIVE TREATMENT

Major Surgery Hematocrit Values, Plasma Protein Determinations, Protein Fraction (Grosschirurgische Eingriffe, Haematokritwert, Plasma Eiweißquantum, Eiweißfraktion) I DISCHERT *Wsch.* med. Wschr., 1948 98 394.

Using the Kjeldahl method the author made 140 plasma protein serum protein and fraction protein determinations on 233 patients.

The plasma protein value was sometimes higher than normal when the body weight corresponded to the body height or the ratio was abnormally high. Only malignant myelomas revealed an exception in spite of a great loss of weight, the plasma protein may be as high as 14 gm. per cent instead of the normal 6.5 to 8.0 gm. per cent. Hypoproteinemia was found in accident cases and was probably due to the effect of shock, a similar condition was noticed also in patients with chronic inflammatory processes, chronic suppurative conditions such as empyema or phlegmons, also nephrosis complicating surgical conditions of the kidneys, grave gastrointestinal lesions such as ulcerative colitis echinococcus disease certain cases of carcinoma, malnutrition and in patients with Witzel's fistula.

An increase of globulins was found in patients with phlegmons and certain patients with pulmonary tuberculosis. Only 25 per cent of 24 patients with bronchial carcinoma showed a decrease in the albumin-globulin ratio. The hematocrit values were found increased in idiopathic and symptomatic polyglobulia resulting from peripheral stasis or dehydration following vomiting diarrhea, or burns. An acute rise of hematocrit values in patients who had not received a blood transfusion was a sign of a fatal outcome.

A rise of gamma globulins was observed after the extirpation of an echinococcus cyst from the upper lobe of the right lung.

Numerous observations on patients who underwent pneumonectomy showed a diminution of plasma proteins reaching 1.75 gm. per cent. An exception to this rule may be found only in relatively young patients.

Unless there are great blood losses or a considerable fall of the blood pressure during the operation plasma protein and hematocrit values usually return to normal levels after a transfusion of approximately 600 c.c. of blood. A transfusion of much larger amounts may embarrass the circulation and prevent the reticuloendothelial system from an intensive formation of antibodies because the system may become exhausted by phagocytosis of foreign erythrocytes brought into the organism with the transfused blood. Unless a transfusion is given for the purpose of replacing considerable losses of blood its aim is to stim-

ulate the bone marrow. This task is accomplished by bilirubin or urobilin liberated from phagocytized erythrocytes. The stimulated plasma cells in the bone marrow form plasma proteins especially globulins, thus the rise of globulins after a transfusion is explained.

The operative shock is responsible for a fall in plasma proteins. Furthermore a loss of proteins by muscles of a bedridden patient after the operation leads to a loss of proteins in the blood.

Contrary to the statement of some American writers plasma protein contents as low as 5.5 gm. per cent never caused edemas in the author's material of 235 patients, no matter whether they were operated on or not.

A protein rich diet combined with the administration of large amounts of fats and carbohydrates proved to be the most efficient remedy to combat the postoperative hypoproteinemia.

The author recommends a blood transfusion 2 or 3 weeks after pneumonectomy if the postoperative course is uneventful, in order to raise the plasma proteins, because as a rule the patient shows a fall of such proteins. JOSEPH E. NARAT M.D.

## ANTISEPTIC SURGERY; TREATMENT OF WOUNDS AND INFECTIONS

Primary Tendon Repair JOSEPH L. POSEH. *Swg.* Clin. N. America 1948 38 1323

The author reviews the treatment of 187 cases of injuries of the tendons and nerves of the hand and wrist at the Detroit Receiving Hospital, Detroit Michigan during 1947. Case histories representative of the various types of injuries are presented in detail. In general the principles outlined by Koch, Mason and Allen were followed.

Emergency room care consisted of establishment of the diagnosis without interference with the wound. Tetanus antitoxin was administered and the patient was prepared for admission to the operating room. Although the author states that general anesthesia is preferred the majority of patients were operated upon under brachial block or local infiltration of novocain.

Cleaning of the wound with soap and water was performed in the operating room. A bloodless field was maintained by the use of a blood pressure cuff inflated to 250 mm. of mercury, which is released every 15 hours during the procedure. Adequate exposure without unduly across skin creases is stressed. Tendons were approximated with No. 60 cotton suture by the technique developed by Mason and Allen. Because of the difficulties in its use, the Bunnell pull out wire technique was abandoned although the author states good results were obtained in the few cases in which it was used. Splinting was maintained by the use of plaster molds and pressure dressings.

When possible, the primary dressing was not changed for a period of 10 to 14 days.

When the flexor tendons were found to be divided within the sheath, only the profundus tendon was repaired, the sublimis tendon being excised. Both tendons were repaired when the laceration was in the palm or wrist. Of 43 patients with severed tendons at the wrist, 28 had associated nerve injury.

Of the extensor tendons, the extensor pollicis longus caused the most difficulty in care. Secondary tenorrhaphy was necessary in 5 of 8 cases in which primary repair had been carried out. The author attributed the cause for failure to premature removal of the splint. For extensor tendons, he advocates the application of a splint at night for 3 weeks following removal of the original splint at 3 weeks postoperatively.

Only 3 patients were operated upon later than 6 hours after injury; the majority of the operations being performed in 4 to 6 hours after the trauma. Penicillin, if used, is given intramuscularly, and its use locally is condemned by the author. From the experience of the Hand Clinic at Detroit Receiving Hospital primary tendon suture is recommended.

JOHN L. BELL, M.D.

**Some Observations on Anemia in Patients with Burns.** F. BRANTERWATTE and F. T. MOORE. *Brit J Plast Surg* 9:45, 8

The object of this article is to draw attention to the importance of the nutritional factor especially protein depletion in anemia resulting from burns. Most patients during the period of their recovery from burns show a diminution in their blood hemoglobin values. The patients whose burns are less severe can, with dietary assistance, correct the anemia. In contrast, the patients whose burns are more severe need careful observation, prolonged treatment, and repeated blood transfusions. The important feature which separates these two classes is the extent of the total skin loss.

The first blood change to be noted as a result of burning is hemoconcentration. Following the intravenous infusion of plasma, hemoconcentration is controlled within 3 or 4 days. The hemoglobin of patients whose area of total skin loss is less than 10 per cent falls to 85 to 90 per cent return from this level is usually spontaneous and complete before the second week has elapsed.

The anemia arising from burns, associated with a percentage area of total skin loss greater than 15 per cent, is persistent and reacts only to transfusions of whole blood. Healing of the burned area is really the key to the situation, but the anemia will not be relieved until the burn is healed, and the burn will not heal until the hemoglobin is over 60 per cent. Repeated transfusions are the only solution and are the routine measure applied.

Attention is drawn to the anemia that follows plasma infusions given when the patient is at the stage of hemoconcentration. There is no direct relationship between the amount of plasma infused to

prevent hemoconcentration and the subsequent degree of anemia. A marked hemoconcentration is not necessarily followed by a marked degree of anemia. Hemoconcentration bears a relationship to the total area burned, but the subsequent anemia bears a relationship only to the extent of the total skin loss.

The anemia that follows the phase of recovery from hemoconcentration is directly related to the extent of the raw areas. The more extensive the area of total skin loss, the more profound is the ensuing anemia. This is in effect an alternative way of saying that the significant factor in the subsequent anemia is the area of granulation tissue that arises as a result of skin loss.

It has been shown by Cope (1943) that during recovery from burns, a period of negative nitrogen balance occurs and during this period of protein catabolism the protein stores of the body are depleted.

In a patient suffering from extensive skin loss due to burns the daily excretion of urinary urea rapidly rises and is coincident with a rapid fall in the blood hemoglobin and the plasma proteins. Blood transfusions may control the decreasing blood hemoglobin if given in sufficient quantity. Four of the patients seen with severe burns developed a picture resembling that found in tropical nutritional anemia or sprue. They showed a variety of types of anemia without leucopenia, asthenia, wasting, sore tongue, diarrhea or bulky fatty stools.

Cases are presented which suggest that the resistant anemia that occurs after the initial stages of a burn is closely related to and runs parallel with disturbances of the nutrition. In the first group the protein loss was the most operative factor. In the second group a sprue-like syndrome had added to the difficulties of the patient in absorbing and retaining the factors needed for red-cell formation. Hematinic factors liver iron, or vitamin B will not prove suffice to correct this anemia. The evidence suggests that the operative factor is loss of protein.

Whipple and his co-workers have produced much experimental evidence stressing the importance of adequate protein intake for hemoglobin formation. They have found that the globulin necessary for hemoglobin synthesis is found in most meats, and in classical experiments showed that liver by mouth, especially beef and chicken livers had a more important influence on hemoglobin production than any other protein-containing food and all the work since then has suggested that it is factors other than antianemic liver factors used for pernicious anemia that are of importance. Liver is a rich source of amino acids. Experiments by Whipple and others point to lysine as the important factor. Others are important for plasma production, but practical experience has proved that plasma infusion will not correct the anemia of burns.

The reason for the development of the sprue-like syndrome in 4 patients is not clear, but the administration of 30 gm. of sulfonamide might have interfered with the intestinal synthesis of vitamin B.

Leucopenia did not occur so that an inhibition of marrow activity by sulfonamide cannot be postulated as a cause of the anemia. Hemolysis as a cause of anemia relates to the early stages of the burn; no evidence has been produced showing that in the later stages hemolysis occurs. There is thus a good body of evidence pointing to the importance of protein intake that is to say food protein with serious burns. The practical effect is that patients suffering from severe burns must be given a high mixed protein diet that the hemoglobin must be maintained above 60 per cent, if healing is to occur and that hematitics alone cannot be expected to correct the fall in the blood hemoglobin.

FRANK P. KANTHA, M.D.

**Infection Through Soaked Dressings.** LEONARD COLLEBROOK and A. M. HOOD. *Lancet* Lond. 1948, 2: 682.

To investigate the possibility that outside contamination could traverse several thicknesses of an intact, sterile, moist dressing and infect an underlying wound the authors constructed a model wound which consisted of a section of brass tubing with several holes drilled near one end. Wicks of gauze were placed through these holes to facilitate seepage of fluid from gauze which had been moistened and placed loosely within the tube. A sterile dressing was bandaged over the holes and the tubing was laid horizontally on a piece of filter paper placed within a copper container and the entire apparatus was autoclaved.

In simulating wound contamination the innermost gauze was saturated with a mixture of plasma and nutrient broth and the outside of the dressing was infected by adding cultures of bacteria to the filter paper. The model was incubated and cultures taken from the inner gauze showed that infections of the *Pyococcus*, *Staphylococcus aureus*, *Proteus*, diphtheroid bacillus, *Streptococcus hemolyticus* and coliform bacillus readily traversed the dressing. Motile organisms passed through in a few hours; streptococci and staphylococci took up to 48 hours to penetrate. It was found that a plaster of paris shell over the bandage did not interfere with the passage of organisms but that cellophane or other impervious plastic was an effective barrier.

The authors suggest that some hospital cross infections may occur in a manner similar to their experiment. A plastic sheeting which is pervious to water but impervious to bacteria is undergoing further investigation as a possible barrier to infection which might be incorporated in dressings.

WAYNE FIELD CAMERON, M.D.

**Penicillin in Tetanus.** R. S. DIAZ RIVERA, LUIS R. DIAZ, and JOSÉ BERRIO-SUÁREZ. *J. Am. M. Ass.*, 1948, 133: 191.

Because of inadequate methods of therapy tetanus remains one of the most dangerous of wound infections. It has been shown that tetanus antitoxin is of limited value after a large amount of toxin has been fixed by the central nervous system.

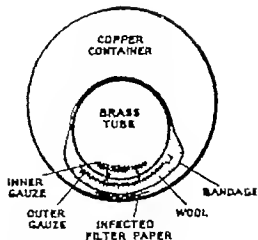


Fig. 1 (Colebrook and Hood) Apparatus used in experiment described in text.

Between July 1945 and March 1947 the authors treated 59 patients at the San Juan City Hospital, Puerto Rico (2.4 per cent of total admissions). The known incubation periods varied between 1 day and 3 months, with an average of 8.4 days for the total group and an average of 5.7 days for the cases in which the outcome was fatal.

Generalized tetanus developed in 56 patients and cephalic tetanus in 3. All but 18 patients had convulsions. Leucocytosis was present in 35 per cent of the cases. Therapy consisted of the intravenous administration of 100,000 units of antitetanic serum upon admission and frequently in addition intramuscular injections of 100,000 units. Wherever possible local excision of the port of entry was performed after injection of the surrounding tissues with 20,000 units of antitetanus serum and open wound treatment with  $H_2O_2$  was instituted. For a period of 1 to 3 days 5,000 to 10,000 units of antitetanus serum were given intramuscularly. 5 per cent dextrose in isotonic sodium chloride was given intravenously and a stomach tube for nutrition was used in the patients who were more seriously ill. Phenobarbital sodium injected hypodermically in doses of 2 gr (0.13 gm) every 2 to 3 hours helped to control convulsions. ether in oil by rectum was used also. Penicillin in doses of 15,000 to 20,000 units was given intramuscularly every 3 hours.

The mortality rate was 20.3 per cent. The average hospital stay for the whole group was 19 days and the average total amount of penicillin received was 1,800,000 units. The patients who died had received an average of only 796,000 units of penicillin. The duration of the convulsions was not shortened by penicillin nor by tetanus antitoxin.

A short incubation period and the rapid onset of convulsions are bad prognostic signs. This is true also when the port of entry is in the head. The causes of death in 12 patients were respiratory paralysis and toxemia in 7, bronchopneumonia in 4 and extreme dehydration in 1 patient. Severe serum sickness was considered a contributory factor in 1 patient.





pantocain and a 0.5 per cent pantocain-0.6 per cent periston solution with 1 drop of 1 to 1,000 suprarenin solution per 5 c.c. The body weight of the child was used as a practical guide to the dosage of pantocain aqueous solution of pantocain in children of from 0 to 12 years weighing from 2 to 35 kgm. ranged from 2 to 12 c.c. and that of the 0.5 per cent pantocain 0.6 per cent periston solution in children of from 6 to 12 years weighing from 20 to 35 kgm. ranged from 6 to 8 c.c.

No preparation was used for infants. Very restless children were given from 0.2 to 0.5 c.c. of luminal sodium in the first year of life and from 0.5 to 1 c.c. in the second to the fifth year only after the sixth year was from 1 to 1.5 c.c. administered regularly 1 hour before anesthesia.

Puncture is usually performed in the sitting position with a needle 3.5 cm. long graduated in centimeters and having a point bevel of 45 degrees. In the nursing the depth of the puncture is usually less than 1 cm. in children of from 5 to 7 years it is about 2 cm. The adaptability of the circulation of children to peridural anesthesia is extraordinary and prophylactic measures against circulatory changes are unnecessary. The aqueous solution of pantocain is indicated in children under 6 years the pantocain periston solution is used in appropriate cases after the age of 6.

In the beginning the authors did not use the method in children with severe peritonitis nursings with ileus and the newly born. At present practically all interventions below the xiphoid are performed under peridural anesthesia even in nursings and the newly born the only exceptions are those for spasm of the pylorus anal atresia and myelomeningocele which are done under local anesthesia. The use of the peridural method is recommended particularly in orthopedics since it provides ideal muscular relaxation.

Peridural anesthesia is valuable as a therapeutic measure without subsequent operation in ileus of nursings. In incarcerated hernia it causes relaxation of the abdominal wall with enlargement of the hernial opening reduction of the hernia by simultaneous stimulation of peristalsis then occurs spontaneously in some cases and is facilitated by taxis in others. Recent intussusception can be reduced manually through the relaxed abdominal wall.

RICHARD KEMEL, M.D.

Experiences with Procaine Administered Intravenously CHARLES M. BARBOUR and RALPH M. TOWELL. *Anesthesiology* 1948, 9 514.

In the present article, the authors recount the history of the intravenous administration of procaine hydrochloride and report their personal experience with the use of this therapeutic measure in a weak concentration (0.1% solution). It has been used for numerous purposes. The intravenous administration of procaine provided adequate analgesia for the transportation of battle casualties and produced

alleviation of pain during surgical dressings of burns. It has been effective in combating deleterious cardiac arrhythmias in the presence of an emergency and as a prophylactic measure immediately before and during the operative procedures involving intrathoracic structures likely to produce these untoward cardiac effects. It serves as a substitute in many instances for morphine in the control of postoperative pain and for patients suffering from spastic diseases and arthritis. It has been adopted by others for use in patients who present rapid irregular cardiac rates before and during general surgical procedures. In weak solutions procaine hydrochloride has been employed during operations within the neck when such syndromes as bradycardia, hypotension and progressive cyanosis appear. For the treatment of cardiovascular emergencies the employment of analeptics has been discarded for the use of intravenous administration of glucose in distilled water or saline solution whole blood or blood fractions to assure adequate cardiac filling together with the intravenous use of procaine in 0.1 per cent concentration to reduce futile activity associated with excess irritability. Intravenous procaine is of therapeutic value in the management of patients suffering from pruritus associated with jaundice contact dermatitis and exfoliative dermatitis. The relief from itching has lasted from 4 to 18 hours following an infusion. The optimum time to administer the drug is in the evening thus permitting sound sleep. Preliminary skin tests are performed.

Procaine has been used successfully for the treatment of urticaria associated with the administration of blood. The management of patients suffering from burns offers the anesthetist a real opportunity to contribute to the comfort of these people irrespective of the severity of the burn.

The sympathetic effect is in early and definite action of procaine. For these sympathetic effects it is used in the treatment of thrombophlebitis. Though not extensive the results with this agent in the treatment of skeletal muscular spasm have been encouraging.

It must be remembered that the drug is convulsant. Its use in concentrated solutions or rapid injection of dilute solutions may cause untoward reactions that will not only jeopardize the patient's life but will bring this method and agent to disrepute.

MARY KARP M.D.

Pentothal-Curare Solution. Observations on Its Use in 599 Cases. JOE W. BAIRD. *Current Res Anesth.* 1948 27 336.

Pentothal-curare solution in combination with 50 per cent nitrous oxide and 50 per cent oxygen seems adaptable to almost all types of operations and for all age groups. One of the greatest advantages of this type of anesthesia is the complete elimination of the fire and explosive hazard.

Because of the minimal alteration of the normal physiology by the various components of this anes-



# PHYSICOCHEMICAL METHODS IN SURGERY

## ROENTGENOLOGY

Some Observations on the Roentgen Diagnosis of Nonopaque Foreign Bodies Aspirated into the Bronchi  
SÖLVE WELIN *Acta radiol. Stockh.* 1948, 39: 539

During the last 4 years 13 cases of aspiration of organic foreign bodies have been found at the Caroline Hospital in Stockholm, and although such foreign bodies are commonly classified as nonopaque to roentgen rays the effort was made to visualize the aspirated body roentgenographically through the use of heavily exposed posteroanterior and oblique views the latter so angled as to throw the air column of the main bronchus of the affected side into relief against the gray shadow of the mediastinal structures, and thus obtain an air bronchogram. The technical factors recommended for adults were 80 to 90 kilovolts 0.05-0.1 seconds 300 milliamperes while for children the exposure time may vary from 0.03 to 0.8 seconds. A stationary Lysholm grid has been needed except in the case of the youngest children.

By this method it was possible, in 7 cases to demonstrate a single foreign body directly. These cases also showed roentgen evidence of valvular obstruction, but not of atelectasis. At bronchoscopy the aspirated body proved to be a nut kernel in 3 instances, a bit of fruit, vegetable or gristle in 3 others, and resin crystals in the seventh case.

In 5 other cases there was atelectasis of a whole lung secondary to obstruction of a main bronchus by a mass showing a rounded configuration of its air illuminated superior surface, at once giving the impression of a rounded foreign body. One of these cases showed in addition, a small rounded mass outlined against the main air column about 1 cm. proximal to the point of total obstruction. At bronchoscopy two peas were taken from the latter patient and one pea was taken from the other.

The remaining 4 cases showed only a sharp straight line interruption of the main bronchial air column with associated atelectasis of one lobe or portion of a lobe. Although the straight line appearance was not so suggestive of foreign body the history of sudden onset of obstructive symptoms supported that possibility and confirmation was obtained at bronchoscopy in each instance with removal of 2 peas in 2 cases and of an ear of wheat in 2 others.

Except for one woman of 40 these patients were all young children aged from 1 to 7 years. Two of the cases came to attention within 24 hours but some had been undiagnosed for more than a month. In view of the risk of secondary infection in such cases prompt diagnosis is of great value and in the author's experience the method outlined above has proved of distinct help in some instances in rapidly establishing a diagnosis.

LILLIAN DONALDSON M D

Studies of Roentgenologic Images of the Gastrointestinal Mucosa. Particular Appearances of the Mucosa of the Cecal Portion of the Ascending Colon in the Syndrome of the Right Lower Abdomen (Studi sull'immagine radiologica della mucosa gastro-intestinale. Particolare aspetto della mucosa del ceco-ascendente nella sindrome addominale destra). ANTONIALE CASATI. *Radiol. med.* Milano 1948 34: 593.

A method for examining the mucosal markings in the gastrointestinal tract has been described in previous communications. This has consisted essentially in the administration of 100 to 160 c.c. of an aqueous 20 per cent solution of colloidal barium sulfate (Molteni) by mouth after a cleansing enema and followed after 2 hours by a light meal. The pictures are taken about 15 hours after the ingestion of the shadow casting material. In this report the author gives his experiences with cases of painful syndromes in the right lower quadrant many of the patients had been appendectomized with persistence of pain.

The usual finding has been stippled circles of shadow in the partially (naturally) distended cecum. These circles have been of various sizes but usually small or about the size of a large grain of barley. This circular mottled appearance is ascribed to a tumefaction or hypertrophy of the intestinal lymphatic system induced by an interference with the excretion of bacteria or their toxins into the bowel lumen at this point. The lymphatic system here exercises a cushioning effect between the inner and outer surfaces of the bowel wall and connects up with the lymphatic system in the retroperitoneal tissue which may also be affected.

The author believes that his method, which he designates the method of scarce hilling can be used to find the residual or even silent colonopathia in these cases and that a carefully taken anamnesis and his method of visual palpation with the aid of the sigmoidoscope will differentiate between the involvement of the bowel wall itself and that of the neighboring lymphatic structures. However he leaves the delimitation and analysis of the clinical applications of this method to a future communication.

JOHN W BRENNAN M D

Tuberculosis of the Stomach and Duodenum. HERMAN W OSTROM and WILLIAM SKERBER. *Am J Roentg.* 1948 60: 315

Gastric and duodenal tuberculosis are uncommon lesions. When found they are usually associated with tuberculosis elsewhere in the body, although not necessarily the pulmonary type. The incidence of gastric lesions as reported by various groups is from 1 case in 21 000 autopsies to 0.34 per cent reported by the Mayo Clinic. Duodenal disease is



afterward and continued at intervals until the terminal ileum was filled. A cobblestone appearance of the mucosal pattern of the terminal ileum was noted in every case. None of the children had any tenderness or a palpable thickening of the terminal ileum.

In one case, a child 17 months of age died of acute laryngotracheobronchitis. At autopsy numerous lymphoid cell collections were found in the terminal ileum, projecting above the level of the surrounding mucosa. Roentgenograms of a specimen of the terminal ileum after barium was smeared on its mucosal surface exhibited a typical cobblestone appearance. It is pointed out that the child died only 12 hours after the onset of the disease. Autopsy after a chronic illness with wasting may not lead to such good visualization of the pattern since the usual normal amount of lymphoid tissue is considerably reduced.

Golden described a similar cobblestone appearance of the terminal ileum in adults but in his cases there was evidence of right lower quadrant pain and condition to inflammation. He attributed the tender ileum was palpable. He attributed the condition to inflammation.

Further investigations are necessary to establish the age at which the cobblestone pattern of the normal ileum in children is no longer produced.

T. LEUCUTIA, M.D.

**Roentgen Ray Diagnosis of Malignant and Potentially Malignant Lesions of the Colon and Rectum.** JOSEPH C. BELL and JAMES B. DOUGLAS. *Radiology* 1948, 51: 297.

The authors state that in the past few years it has been noted that patients with cancer of the lower bowel are reporting earlier for examination than was the case in years ago. For this reason the problem of diagnosis is correspondingly more difficult.

According to Whitehead 17 per cent of all deaths caused by cancer are traceable to cancer of the colon or rectum. That much can be done to prevent or postpone many of these deaths is shown by the statistics of Rankin and Johnston who in a series of 453 patients operated upon for cancer of the colon obtained 52.6 per cent of 5 year cures. When the lymph nodes were not involved the percentage was 25 per cent higher than among those in whom the nodes had been invaded.

Boehme and Hanson in reviewing 1,457 cancers of the large bowel found that the site of the lesion in 5 per cent of the total number of patients was located in the sigmoid, rectosigmoid and rectum approximately 50 per cent being in the rectum.

The authors emphasize that in making a roentgen examination of the colon a preliminary physical examination including digital rectal exploration is important. The history taking must list in order of change in bowel habits (1) recent change or absence of pain indicating interference with passage of material through the bowel (2) rectal bleeding its character duration and amount (3) indigestion and (4) evidence of progressive anemia. Since 65 to 75 per cent

of all cancers of the colon and rectum can be visualized with the sigmoidoscope and biopsy secured this procedure also should precede roentgen examination whenever possible.

In addition to the roentgen technique generally employed the authors use a film variant which is made possible by a three-contact quick change-over switch control attached in parallel with the change over switching apparatus in the spot film tunnel. This permits exact exposure on the film of any fluoroscopic image of interest. Serial exposures often proving of inestimable value especially in differentiating a diverticulum secondary to a diverticulitis from a cancer. Even in cases in which a preliminary sigmoidoscopic examination reveals the presence of a cancer polyp or other abnormality a roentgen study of the entire colon is indicated.

A defect due to an organic lesion is constant therefore whenever there is any doubt about its nature the roentgen examination should be repeated after a thorough cleansing of the bowel.

The double-contrast examination is of great aid in the demonstration of polyps and to a lesser degree in the diagnosis of early cancer or when a cancer is located in the right side of the colon. It is not a good procedure to follow a routine barium enema with a double contrast enema and it is best to do them separately since they require entirely different techniques. These techniques are described in detail. The article is illustrated with some unusual roentgenograms obtained by both the barium enema and the double-contrast enema techniques.

T. LEUCUTIA, M.D.

**Congenital Valvular Formations in the Urethra.** SIGVAARD JOAUP and SVEN ROLAND KJALLBERG. *Acta radiol. Stockh.* 1948 30: 197.

The authors present 6 cases of congenital urethral valves which is a relatively uncommon condition. The patients were between the ages of 3 weeks and 37 years.

The method of demonstration of the condition is to inject the urethra with opaque contrast material which is soluble in water. Roentgenograms are taken during the injection of the material and on micturition. The valves appear as thin fin-shaped defects in the contrast study. The prestenotic posterior urethra is usually greatly dilated with an inferior convex or slightly conical surface of limitation. The thickness of the valve cannot usually be determined. On account of the obstruction in the passage only a thin ribbon of contrast medium is observed in the urethra below the valve formation. Early diagnosis of congenital urethral valves is urged to avoid urinary tract enlargement.

FRANK L. HUSKEY, M.D.

**Visualization of Patent Ductus Arteriosus Botalli by Means of Thoracic Aortography.** G. JOSSON, B. BÄCKEN, H. E. HANSSON and J. KARNELL. *Acta rad. Stockh.* 1948 30: 81.

After a very brief summary of the current literature dealing with angiocardiography and angio-



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graphy the authors summarize the technical disadvantages of the practice as follows:

While angiography offers fine visualization of the right chambers of the heart and the pulmonary artery, after the medium passes through the pulmonary section of the circulation the dilution increases to such an extent that visualization of the left chambers and of the aorta is incomplete. This particularly complicates the diagnosis of patent ductus arteriosus because when the opacity of the medium has reached its maximum in the aorta there is still so much opaque substance left in the pulmonary vessels that the outlines of the aorta become difficult to distinguish, and for this reason a communication between the pulmonary artery and the aorta becomes impossible to localize.

In a previous article in the same journal the authors have described their technique for thoracic aortography by catheterization from the right radial artery. In the present article they illustrate and describe 3 cases of patent ductus anomalies accurately visualized preoperatively by this technique. They express the opinion that thoracic aortography is more helpful than angiocardiology and hope to develop the technique so as to render possible an accurate determination of the length and width of the ductus preoperatively.

JAMES C. MACMILLAN, M.D.

Visualization of the Coronary Arteries. GONNAR JONSSON. *Acta Med. Scand.* 94B, 29, 350.

In order to study the great vessels of the upper thorax in patients with such conditions as patent ductus arteriosus, at the Södersjukhuset Clinic and the Sabbatsberg's Hospital in Stockholm, Sweden, the author used the method of thoracic aortography through catheterization of the radial artery as described by Radner and by Brodén-Hansson, and Kærnall in 1948. An incidental finding in 5 of the patients was visualization of one or both coronary arteries. The films of 3 of these patients, aged 27, 46, and 22 years respectively, are reproduced chiefly in lateral view and show the coronary arteries clearly over a large extent of their main channels. No untoward symptoms resulted from the injection and the electrocardiogram in each case had the same appearance before and after the roentgen examination.

The author points out that in order to get opaque substance into the coronary arteries in adequate concentration for visualization the injection should be done with the catheter inserted far down in the ascending aorta, preferably with the tip resting near the semilunar valves. The latter were well visualized in all 5 cases.

LILIAN DONALDSON, M.D.

Cancer of the Larynx. Five-Year Results of Radiotherapy. MAX CUTLER. *Radiology* 94B, 5, 509.

The efficiency of radiation therapy was studied in 107 consecutive cases of cancer of the larynx.

In recent years there has been a trend in some institutions to treat early laryngeal carcinoma by rad-

iation therapy with a 5 year survival rate of from 50 per cent (Blady and Chamberlain) to 85 per cent (Kramer).

A plea is made for a more careful anatomical classification of tumors. The use of intrinsic and extrinsic lesions leads to confusion.

In all cases, a total dose of from 6,000 to 7,000 roentgens is given in an 18 day period. Early lesions are given 100 roentgens twice daily which are gradually raised to 150 roentgens. More extensive lesions are given 85 roentgens twice daily which are gradually raised to 275 roentgens. In both instances, there is a gradual diminution of the portal size with an intensity rate of 6 to 7 roentgens per minute at a target distance of from 75 to 110 cm.

Of the group of 107 unselected cases, more than half were inoperable and the 5 year cure rate was 35 per cent. In this group the 5 year cure of operable cases was 52 per cent and in early operable lesions 60 per cent, whereas in inoperable lesions it was 20 per cent.

The author is of the opinion that radiotherapy is indicated when the cords are freely movable or partly fixed. Laryngectomy is indicated if there is fixation of the cords. With improvement in radiation technique as well as early diagnosis, the need for total laryngectomy should be diminished further.

MAURICE D. SACKS, M.D.

The Gastroscopic Picture in Postirradiation Gastritis. EMMET D. PALMER. *Am. J. Roent.* 94B, 60, 350.

The author presents what is believed to be a new gastroscopic entity—postirradiation gastritis—as observed in 12 patients who were treated for malignant conditions while in the Armed Forces. The histopathological diagnosis in each case was as follows: retroperitoneal retrocolic sarcoma in 1 case; sarcoma in 2 cases; malignant teratoma in 3 cases; and embryonal carcinoma of the testis in 4 cases.

Radiation therapy was given with factors of 1,000 kilovolts, 3.6 mm. lead, 3 milliamperes, 70 cm. distance through five portals constant in size and position in all patients. The gastric area was included in two of these portals—a 10 by 10 cm. epigastric portal and a 10 by 15 cm. lumbodorsal portal. The total skin dose to each field varied from 4,800 to 5,600 roentgens given over a period of 49 to 76 days in 12 patients and from 2,400 to 3,800 roentgens administered over a period of 3 to 55 days in 8 patients.

Only those areas of the stomach which had been directly in the path of roentgen irradiation showed changes demonstrable by endoscopy. These relatively constant and characteristic gastric changes consisted of marked edema, with tubular deformity and fixation of the antrum, similar fixed patulousness of the pylorus, and clean, deep chronic ulcers which healed without contracture. Pathologic and roentgenographic studies in general corroborated the gastroscopic findings.

The radiation dosages used in 11 of these patients were from two to three times that believed necessary



(by most therapists) to destroy lymph node metastasis from such radiosensitive tumors. In fact, the findings are those which might be anticipated following such intensive irradiation of the gastric mucosa. The department of radiation therapy at this hospital has now succeeded in balancing the minimum effective dose against the maximum safe dose so effectively that the gastrointestinal section does not expect to see any more postirradiation gastritis.

JOHN H. FREED M.D.

**Precision Dosage in Interstitial Irradiation of Cancer of the Cervix Uteri.** JAMES A. CORSCADEN, S. B. GUSBERG and CHARLOTTE P. DONLAN. *Am J Roentg* 1948 60 522

The authors have devised an arrangement of needles to deliver adequate radiation to the cervix and the paracervical and lateral parametrium. Expressed in the terms of gamma roentgens it is commonly accepted that 7,000 gamma roentgens or more applied to a cancer cell will destroy it without severely injuring the normal tissues. With 15,000 gamma roentgens all tissues are destroyed and a slough is created. The problem thus in the treatment of carcinoma of the cervix is to deliver to all accessible regions a dose adequate to destroy cancer without causing excessive injury to the normal tissue. By the use of the precision stereoscope the location of the radium units can be accurately determined; the distances between them measured and the dose calculated. The authors learned that needles could be introduced with a considerable degree of accuracy into the positions previously planned. Therefore an arbitrary pattern was devised which delivers apparently adequate radiation to all points in the uterus and parametrium. In this pattern 3 mgm. tubes are placed end to end in the intrauterine tandem. About this tandem eight 3.2 cm. needles were placed in stockade fashion for a radius of 1.5 cm. One and a half centimeters lateral to this and 1 cm. apart two 3.2 cm. needles were placed parallel to the axis of the uterus in the sagittal plane. One and a half centimeters lateral to these or 4.5 cm. from the cervical canal five 6 cm. needles were placed parallel to the pelvic wall 1 cm. apart. With this pattern 21,010.8 gamma roentgens will be delivered to the cervical mass. To the paracervical region 14,346.7 gamma roentgens will be delivered and to the lateral parametrium near the pelvic wall 10,803.1 gamma roentgens will be delivered. It was found that the needles could be placed with considerable accuracy through a vagina which was not greatly deformed. The precision stereoscope is used to determine the distribution of the radium and the dose of radiation received by the tissues is calculated. Deficiencies in dosage may be determined and corrected.

The principal objection to the method is that it is blind and that radium needles are likely to injure the intestines, bladder and ureter. It requires precise knowledge of the anatomy of the pelvis, some degree of surgical dexterity and a knowledge of the

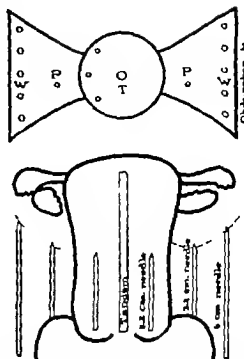


Fig. 1 (Corscaden et al.) Diagram to show arrangement of needles to deliver apparently adequate radiation to the cervix, the paracervical region, and the lateral parametrium. Cervical mass—11,010.8 r. Lateral pelvic wall at W—10,803.1 r. Paracervical area at P—14,346.7 r.

principles of irradiation technique. Clinical results are not presented in detail. All of the patients treated by this method had extensive involvement of the parametrium and were classified as being in stage 3 (League of Nations). The immediate results in the use of this method are striking and unmistakably superior to those following the use of intracavity technique.

FRANK L. HURSEY M.D.

**Rubber Cassette with Intensifying Screens Designed for Roentgen Examination of Operatively Exposed Organs.** OLLE OLSSON. *Acta radiol* Stockh. 1948 30: 91

Although the roentgenologic examination of the kidney at the time of operation is not a new procedure, the attention of the reader is directed to a refinement of the procedure involving the adaptation of intensifying screens in a film package to be used at the time of nephrotomy. In this manner definite x-ray assistance can be obtained in the removal of renal calculi and fragments of calculi.

The author has devised a cassette consisting simply of a flat rubber bag provided with an air withdrawal spout. The screens used are of the type designed for industrial use; they are supplied in standard sizes and are characterized by the fact that the fluorescent coating has been applied to a flexible material. The cassette can be sterilized along with the other rubber articles used at operation. An assistant with sterile gloves loads the cassette in the dark room of the operating department and the mouth of the cassette is closed with a single pair of resection

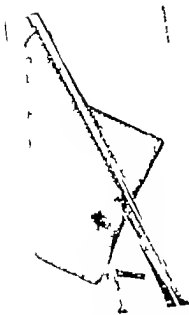


Fig. (Olsson) Caswell loaded and air withdrawn. Illustration shows flexibility of the cassette

tongs which serve as handles for introducing the cassette into the operative field and holding it during exposure (Fig. 1)

Directors of the Surgery Clinic in Lund Sweden believe that the x ray study of the cases with calculi should include

1. Plain roentgenograms of the urinary tract with excretion urography
2. In almost all cases a roentgenogram made just before the operation to check the position of the calculi prior to operation.
3. A roentgenogram of the exposed kidney in every case at least before the termination of the operation.
4. Complete roentgenological examination including excretion urography before the patient is discharged from the hospital

JANE C. MACMILLAN M.D

## MISCELLANEOUS

On the Transmission Through Skin of Visible and Ultraviolet Radiation. A. G. HANSEN. *Acta Med. Stockh.*, 948, Supp. 7

The purpose of this study was to determine by measuring the absorption of radiation by mouse and human skin in vivo and in vitro whether any specific biological effect can be attributed to any wave length between 500  $\mu$  and 300  $\mu$

In chapter I a short account is given of the normal histology of mouse and human skin and the difference in structure between these two types of skin. Chapter II is devoted to a review of the earlier important experimental work done by other authors in this field with a discussion of their methods and results. In chapter III the more commonly used sources of ultraviolet radiation, such as carbon arc lamps and mercury arc lamps, are tested. The Philips super high-pressure mercury arc lamp was finally chosen as the best source of ultraviolet radiation for this absorption study because of its relatively constant supply of ultraviolet rays (when cooled with distilled water) which gave a quasicontinuous spectrum.

The author gives an account of the method of measurement employed in determining the degree of transmission of glass and liquid filters for different wave lengths. In the next chapter the photographic method of determining the degree of transmission with their filtered or spectrally resolved radiation together with the possible sources of error are discussed and the apparatus used in this study is described and illustrated.

Chapter V gives a short account of the method used in preparing frozen sections and microscopic measurements from skin. Although it is shown by experiments on mouse skin that the degree of transmission is changed markedly during storage nevertheless the main course of the transmission curve may for all practical purposes be regarded as independent of the method of storage. Within the wave length region between 500  $\mu$  and 300  $\mu$  the course of the transmission curve is the same for live mouse skin and for skin excised shortly after death. All transmission curves show a minimum at 415  $\mu$  which is attributed primarily to the presence of hemoglobin and perhaps also to cytochrome and myoglobin which are all present in the preparations used and have a characteristic absorption-band at 415  $\mu$ . A series of transmission curves is reproduced for a large number of layers of mouse and human skin.

The results of the investigation show that the transmission of radiation through skin, both (depilated) mouse skin and human skin and through the different layers (frozen sections) of both types of skin, decreases uniformly with the wave length from 500  $\mu$  to 300  $\mu$ . Apart from the minimum at 415  $\mu$ , the various layers of skin do not disclose any characteristic features as regards the absorption of radiation and there is nothing in the results of the measurements of transmission through skin, as performed for the purpose of the present investigation, which indicates that there is any wave-length region between 500  $\mu$  and 300  $\mu$  to which a specific biological effect on skin tissue can be ascribed.

JOHN H. FARRER, M.D

## MISCELLANEOUS

### CLINICAL ENTITIES—GENERAL PHYSIOLOGICAL CONDITIONS

**Adult Gaucher's Disease, with Special Reference to the Variations in Its Clinical Course and the Value of Sternal Puncture as an Aid to Its Diagnosis.** J. GROFF and A. H. GARRER. *Blood* 1948 3 1221

Gaucher's disease is a rare often familial disease distinguished by the presence of characteristic cells in the organs of the reticuloendothelial system. The protoplasm of these cells has a typical cytologic appearance due to the presence of a special lipid the so-called Gaucher substance or kersin.

Helpful clinical signs are splenomegaly enlarged lymph glands peculiar yellow pigmentation which in some cases, develops on the face and in the conjunctivae in the form of wedge-shaped pingueculae characteristic pigmentation on the lower legs a peculiar malar flush and the occurrence of myopia.

The hematologic picture which is not necessarily diagnostic, consists of a hypochromic anemia with leukopenia and thrombopenia normal or low cholesterol of the blood and a hemorrhagic diathesis.

The roentgen examination may be useful in cases in which there are enough accumulated Gaucher cells in bones to produce macroscopic areas of bone destruction. The head and neck as well as the lower end of the femur may be involved.

Despite the presence of these signs the diagnosis may be difficult, and sternal puncture is of importance in the detection of the disease particularly in the detection of subclinical manifestations. Nine cases are reported in which the diagnosis suspected on clinical grounds was definitely established by the detection of the Gaucher cells in the smear of the sternal marrow.

The authors found a marked variability in the clinical picture. Usually the disease is progressive although there may be spontaneous remissions. The rate of progress varies and the patient is usually unaware of its early presence. The earlier the onset, the more rapid the course.

Although the spleen and the liver are the most prominently involved only rarely is the bone marrow spared in Gaucher's disease. Involvement of these organs however does not mean there will be evident roentgen changes. Rare sites of involvement are the lungs the kidneys and the brain. Complications are frequent and vary with the site of involvement. Splenectomy does not seem to alter the course of the disease and need only be done if the spleen itself gives rise to symptoms. Treatment with a purely vegetarian diet appeared to be just as unsatisfactory as splenectomy.

The authors believe that sternal puncture is the only method that will enable the clinician to establish a positive diagnosis of Gaucher's disease. The only

difficulty that may arise is that of differentiating the cells from the large cells that occur in Niemann Pick's disease however the protoplasm in the Gaucher cells is characterized by a fibrillar meshwork whereas the Niemann Pick cells have a foamy appearance. LE ROY J. KLEINBAKER, M.D.

**South American Blastomycosis Associated with Hodgkin's Disease: Anatomoclinical Considerations on a Case (Blastomycose sul-americana associada à moléstia de Hodgkin. considerações anatomo-clínicas sobre um caso)** CARLOS DA SILVA LACAY, J. LOPES DE FARIA, and ROBERTO A. DE ALMEIDA. *MOURA Hospital, Rio* 1948 34 313.

A man of 34 in poor general condition had noted about a year before admission that he was developing some swellings in the neck which gradually became larger. Other swellings appeared in the axillary and inguinal regions and increased slowly in number and volume. From 1 to 2 months ago he began to have difficulty in speaking and swallowing because of some ulcerated lesions on the lower lip and on the gums. Painful mastication compelled him to take only liquid food. Examination disclosed ulcerations on the mucosa of the lower lip gums hard and soft palate and epiglottis. A diagnosis of Hodgkin's disease and of South American blastomycosis was made. He was treated with aminogenol transfusions and glucophysiologic serum and sulfadiazine. He died 10 months later and autopsy confirmed the diagnosis. The blastomycotic lesions involved the tonsils (productive lesion) the larynx (exudative-productive lesion with formation of pseudomembrane) and the liver while the lesions of Hodgkin's disease were found in the right lung the cervical axillary, inguinal lumbar and hepatohilar lymph nodes and the spleen.

It is difficult to determine exactly the port of entry of the *Paracoccidioides brasiliensis* in this case, but the authors believe that the initial lesions occurred in the tonsils. The exudative reaction is explained by the action of the parasite on a debilitated organism with low resistance. It resulted in the deposition of fibrin and the formation of a pseudomembrane. This type of pseudomembranous lesion has apparently not yet been reported in the blastomycosis in general, nor in South American blastomycosis in particular. This case emphasizes the necessity of histologic examination of the tonsils in South American blastomycosis even when they are macroscopically normal and atrophied. It is interesting to note that the lungs and the skin were free of infection.

No paracoccidioidic granuloma was found in the lymph nodes only lesions of Hodgkin's disease. This is also strange since the nodes should not have escaped invasion by the fungus which was probably disseminated by the hematogenous route to reach

the liver. Is it possible that lymph node parenchyma invaded by the granulomatous tissue of Hodgkin's disease does not constitute an adequate milieu for the development of the paracoccidiosis? The association of blastomycosis with other processes, whether infectious or not, deserves the attention of clinicians and pathologists, since in such cases both processes have a mutual unfavorable repercussion in the evolution of the lesions.

RICHARD KRAHL, M.D.

### Streptomycin Treatment of Pulmonary Tuberculosis. Medical Research Council Investigation. Brit. M. J. 945, 769.

The present report on the effects of streptomycin therapy in one type of pulmonary tuberculosis was prepared by the British Medical Research Council. Acute progressive bilateral pulmonary tuberculosis of recent origin bacteriologically proved and suitable for collapse therapy was treated by streptomycin and bed rest. A parallel control group was treated solely by bed rest. Of 107 patients assessed

Because of the limited supply of streptomycin in Great Britain, the Council decided that the findings in a control group treated by bed rest would add to the value of their report. The ratio of male to female patients was about equal and the ages of the patients varied from 15 to 35 years. Patients were assigned to a streptomycin (S) group or a control (C) group at random only after they were accepted as suitable for the investigation. Two grams of streptomycin in four divided doses were given daily for a period of 4 months to the patients in the S group. Although extrapulmonary disturbances were common, toxic reactions did not necessitate cessation of streptomycin therapy.

On admission to the trial 54 per cent of patients in the S group and 46 per cent of those in the C group were in poor general condition. 65 per cent of patients in the S group and 56 per cent of patients in the C group had sedimentation rates of over 50 mm. and a similar ratio of S to C patients had evening temperatures of over 101 degrees. The results of the treatment in both groups were assessed at 6 months and 13 months and show a striking difference in favor of those treated by streptomycin.

At the end of 6 months, 7 per cent of patients in the S group and 47 per cent of those in the C group had expired. Considerable improvement was observed roentgenographically in 51 per cent of 9 patients and in 8 per cent of C patients. Slight improvement was noted in 18 per cent of S cases and in 23 per cent of C cases as compared with 34 per cent in 18 per cent of S cases and deterioration between the two control cases. More S patients than C patients improved clinically but the difference between the two series was smaller than in respect to roentgenological changes. The results in clinical improvement after one year in 100 patients who had been treated by streptomycin however no clinical cures were obtained.

In the patients treated with streptomycin the greatest improvement occurred in the first 2 months and the treatment was of major advantage to the acutely ill patients. Strains of tubercle bacilli resistant to high concentrations of streptomycin were isolated by the end of the second month of treatment in those patients whose sputum remained positive, the possible dangers of dissemination of strains of bacilli resistant to the drug are mentioned. Only 15 per cent of the patients showed negative bacteriological findings at the end of 6 months.

According to the Council, the type of results obtained indicates that streptomycin is of greatest value in cases of pulmonary tuberculosis in which the lesions are acute and of recent development. The use of the drug is warranted in acute contralateral spread after artificial pneumothorax or after thoracoplasty and probably has a place in the preparation for collapse therapy of patients with rapidly advancing lesions. It seems probable that streptomycin resistance is responsible for much of the deterioration seen in S cases after first improvement.

JOHN L. REED, M.D.

### Hydatid Disease of the Liver and Lung and Its Surgical Treatment. GEORGE MANAVOGU, Cyprus M. J. 945, 1012.

With the return of troops stationed in the Mediterranean area of Cyprus and Greece where hydatid disease is frequent, the possibility of this infection should not be overlooked in unexplained liver enlargement or hemoptysis.

Hydatid disease is the disease of countries where sheep rearing is a prominent industry. Dogs infected by feeding on the offal of infected sheep are the chief source of human infection. Hydatid cyst is most commonly localized in the liver and then next most commonly in the lung although it may occur in any part of the human body.

Hydatid cyst is a disease which develops slowly the infection taking place commonly in childhood or adolescence but symptoms seldom appearing before the infected individual is between 25 and 30 years of age. The condition simulates the existence of daughter cysts are in no way indicative of age. There appears to be no special symptom characteristic of the disease, those produced being due to the presence of a tumor causing pressure upon or destruction of adjacent structures. In hydatid of the lung the patient commonly complains for years of a dull pain in the thorax with a dry cough. Sometimes he may expectorate pieces of membrane or have hemoptysis. In hydatid of the liver patients complain for a long time of a dull or stabbing pain in the epigastrium. Sooner or later the tumor is characteristically tense, elastic, and palpable. Advanced in which doubt exists as to the correct diagnosis the following investigations are helpful:

1. Intradermal reaction of Cassel. One-half cubic centimeter of aseptic hydatid fluid is injected

intradermally. A positive reaction is manifested in from 6 to 12 hours by painful infiltration at the site of injection. The reaction was positive in 90 per cent of the cases.

2 The blood count shows anemia and eosinophilia from 5 to 15 per cent.

3 X-rays give most valuable help not only in demonstrating the cysts but also in giving information as to their size, location and number.

The most important complications are suppuration and rupture. Suppuration takes place through invasion by micro-organisms. This blood borne suppuration is often seen in cases with intercurrent diseases. The organisms are usually, staphylococci, streptococci, and coloid bacilli. Rarely anaerobic bacteria are the causative agents. Rupture may be spontaneous or the result of puncture or trauma. It is a most serious complication with a clinical picture and course varying with the organs into which the rupture has taken place. A hydatid of the liver may rupture into the bile duct, abdominal cavity or pleura. A long hydatid may perforate into the pleural cavity, pericardium or bronchus. Perforation into the vena cava and pulmonary artery have been reported. The great mortality is due to sepsis, anaphylactic shock, hemorrhage or asphyxia.

Treatment is surgical and consists of the removal of the parasitic cyst and drainage of the adventitious capsule, i.e. marsupialization. The procedure can be done under local anesthesia. Care must be taken to prevent the cyst fluid from escaping into the pleural or peritoneal cavity. The cyst is punctured and drained and then 10 c.c. of a 2 per cent formalin are injected into the cavity to destroy the hydatid elements. The cyst is then separated from the adventitious capsule and removed. The adventitious cavity must be thoroughly cleaned and dried. When the cyst is in the liver the adventitious cavity is then sutured with interrupted catgut sutures to the peritoneum and muscles of the abdominal wall. A small drainage tube is inserted. In the lung the adventitious cavity is thoroughly dried and cleaned and then closed with interrupted catgut sutures, the sutures being fixed to the thoracic wall. This fixation serves 2 purposes: (1) it secures the suture line against any opening and (2) it causes the formation of adhesions so that subsequent drainage, if necessary, can be done without danger to the pleural cavity.

Postoperative complications include anaphylactic shock, dispersion of the hydatid elements, hemorrhage and secondary infection. All are rare except the latter and that is readily controlled with penicillin.

REV. ELLIOTT LAMAR, M.D.

**Reiter's Disease. A Study of 344 Cases Observed in Finland.** ILKARI PARONEN. *Acta med. scand.* 1948, 151: Suppl. 312.

The author presents an excellent historical review of Reiter's disease with its various aspects and states that articular complications following dysentery were even known to Casellius Aurelianus at the beginning of the fifth century. In connection with this

disease he discusses the history of arthritis, urogenital involvement, lesions of the nervous system, cardiac involvement, the respiratory system, digestive system, and other lesions. He further considers fever, blood studies, pathoanatomical changes, treatment, diagnosis and differential diagnosis, prognosis, duration and recurrence and the etiology and pathogenesis of the disease.

On the basis of his review of the literature the author seeks an answer to the following questions:

1 What is the clinical picture and prognosis of Reiter's disease?

2 Does the available material throw additional light on its etiology and pathogenesis?

The author presents a series of 344 cases, the great majority of which are from the Defense Forces of Finland and were observed in 1943 and 1944.

In about 70 per cent of the cases the complete triad (articular, ocular and urethral manifestations) was present; about 25 per cent showed two of the essential symptoms and 5 per cent showed only one of them.

Articular manifestations were observed in 325 cases (97.3%) of which 316 (97.2%) were polyarthritic and only 9 cases (2.8%) were monoarthritic. The joints of the lower extremities were affected more frequently than those of the upper extremities or the vertebral column—the knee more frequently than the ankle joint. Besides the joints the muscles and tendons were sometimes involved.

Eye affections, with conjunctivitis at the onset, occurred in 89 per cent of the cases; iritis (in 22 cases) and keratitis (in 27 cases) appeared later. The conjunctivitis was characterized by a deep cranberry red color and a velvety surface.

The urogenital organs were involved in 79.3 per cent of the cases, urethritis being the most common manifestation. Cystitis was present in 22 cases (10 of these unaccompanied by urethritis). Nephropathy was present in 9 patients, in 6 of whom it appeared in the form of a mild symptomatic nephrosis; pyelonephritis developed in 2 patients and nephritis in 1 patient. Penis lesions were present in 87 cases (10 of these unaccompanied by urethritis). The testes and epididymis were affected in 11 patients. In 6 of these there was only testicular pain and tenderness without noticeable swelling, but in 3 there developed a unilateral orchitis and epididymitis leading to swelling and induration. In 1 patient a bilateral epididymitis and in 2 a unilateral orchitis.

Dry circumscribed pleurisy was definitely diagnosed in 26 cases (7.8 per cent) and this diagnosis seemed very probable in 48 other cases.

Carditis was observed in 23 cases. In 4 of these there were symptoms and signs of myocarditis and 1 pericarditis. In 26 cases there was evidence of only myocarditis and in 3 cases only pericarditis.

Less common findings were stomatitis and rupia. In one man a bilateral mastitis developed and lasted for a period of 4 months.

Fever was present in 81.3 per cent of the patients. The duration of the fever varied from a period of one



by the periosteum and the overlying parosteal connective tissue. Along its inner surface the tumor was bordered by a smaller or larger zone of sclerosed and often distinctly grooved osseous tissue.

These various gross features found their reflection in the roentgenographic shadow to which they imparted a certain distinctiveness at least when the lesion was in a long bone and had attained appreciable size. However, even here and certainly when in other sites, the exclusion of bone cysts, enchondromas or of foci of fibrous dysplasia may be difficult on the basis of roentgenographic appearance alone.

The authors interpret the lesion to be a peculiarly differentiated connective tissue tumor which exhibits in the course of its evolution certain chondroid and also myxoid traits microscopically. It is composed basically of cells lying loosely in a myxoid intercellular matrix which as the tumor matures may undergo substantial collagenization. The tissue of any particular specimen may also come to simulate cartilage tumor tissue in some or many fields and in its gross appearance it likewise bears a certain resemblance to cartilage. The presence in the tumor tissue of smaller or larger numbers of cells exhibiting nuclear atypism may give an ominous appearance to the cytologic picture of the lesion, which explains why it may come to be misinterpreted as a malignant tumor particularly as a chondrosarcoma.

As indicated the tumor is apparently entirely benign and does not tend to recur after curettage even without supplementary irradiation. Thorough curettage of a large lesion may of course make filling of the bone defect with bone chips or a bone graft desirable.

DAVID H. LYNN, M.D.

#### The Definition of Inoperability of Cancer. GROSS, T. PACE. *Ann. Surg.*, 1945 127 1105

The greatest margin of error in reporting the end results of treatment for cancer may be found in the classification by the reporter of a regional or histologic type of cancer as operable or inoperable. Three factors interplay in the pronouncement of a given cancer as nonresectable by the surgeon, namely: (1) the condition of the patient as regards his age, the existence of degenerative diseases and the complications attendant on the presence of the cancer; (2) the extent of the disease; and (3) the philosophy, mental point of view, and the courage and experience of the surgeon.

The definition of inoperability has an important influence on end results. A distinction should be made between absolute inoperability due to distant dissemination of the cancer and obvious incurability and relative inoperability due to local technical difficulties. No surgeon should perform an exploratory operation unless he is qualified to proceed with the actual removal of the tumor if encountered. Old age should not be a contraindication in itself for surgical exploration. Palliative surgery is recommended when it gives relief even though cure is not technically possible.

Case reports are incorporated to illustrate the arguments presented including also the fact that some patients may be entitled to a second exploration. This may be in spite of the abandonment of a first operation and pronouncement of incurability by a former surgeon because of technical difficulties.

W. FOSTER STOKROOMERY, M.D.

### EXPERIMENTAL SURGERY

**Identification of Pregnanolol in the Urine of 2 Subjects Having Gynecomastia; Its Value as a Test of Hyperfolliculism in Man (Identification du prégnandiol dans les urines de deux sujets atteints de gynécostasie: sa valeur comme test d'hyperfolliculisme chez l'homme).** JACQUES DECOBAT, MAX F. JAILLÉ and J. M. DUBOIS. *Ann. endocr., Par.*, 1948 9 395

From the clinical point of view the 2 subjects observed by the authors had developed gynecomastia after puberty. In the first who was 19 the swelling was moderate and seemed to be regressing; he had no other signs of feminism except some increase in the width of the pelvis. In the second who was 46 the swelling was more marked and associated with moderate adiposity of feminine character which had appeared after the age of 25. He showed a more marked degree of feminism. In both the genital organs were normal, the volume of the testes being even above the average. In the first subject the sella turcica was large without other signs of tumor or hyperfunction of the hypophysis.

From the chemical point of view the 17 ketosteroid rate was abnormally low in the first subject but without clinical signs of male hormone insufficiency it was normal in the second. The excess of phenolsteroids definite in the latter was found in only one of three determinations in the former. However in both the dominant biologic anomaly was represented by the appearance of large amounts of pregnanolol-glycuronate which was chemically identified in the second subject.

Comparison of the elimination of steroids in the 2 subjects with the average obtained in normal persons showed that (1) the hormonal elimination of gynecostatic individual is characterized by a change in the estrogen androgen relationship which rises by increase of the numerator or decrease of the denominator; (2) the ratio of total steroid glycuronates (pregnanolol glycuronate ten to 1) toward one because of the appearance of pregnanolol glycuronate of sodium in normal subjects is about four and the fraction, insoluble in acetone, may be considered as being formed by 4 steroids thrown down in the precipitate and not by pregnanolol glycuronate.

The identification of pregnanolol glycuronate of sodium in the urine of man has not yet been mentioned in the endocrinologic literature. The fact that this substance was repeatedly found in subjects with hyperfolliculism lends to it the value of a real biochemical symptom in this endocrine condition. As an explanation the authors advance the hypothesis

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als of an anomaly of the intermediary metabolism of a steroid hormone deriving from allopregnane. In the normal subject, the latter would be converted into the acetone soluble steroid glycuronate leaving in the urine only some practically unrecognizable traces of pregnandiol-glycuronate. The intervention of folliculine would modify this metabolism and cause the appearance in the urine of sufficient pregnandiol glycuronate to make it possible to isolate, identify and determine the amount of the substance. Inverse ly the fraction soluble in acetone decreases and the ratio of total steroid-glycuronates to pregnandiol glycuronate tends toward one.

From the double clinical and biologic point of view gynecomastia and the other minor anomalies observed in the 3 subjects seem to be less the expression of an insufficiency of their male sexuality than of a sort of bisexuality by the addition of hormonal secretions of a female nature.

RICHARD KROCK, M.D.

#### The Subcutaneous Transplantation of Skin. STUART GORDON. *Brit J Plast Surg* 943.

Many surgeons have implanted skin into the subcutaneous tissues with varying results. A brief outline is given of the experimental and clinical work that has been done including the work of Peier and Paddock, Zimches and Wasiljew, Blair, Harkins, and others. The conclusions seemed to be that

burned cuts grafts (1) heal rapidly and well (2) have great vitality (3) are able to survive under adverse conditions (4) develop a good blood supply (5) gradually assume the function of the parts replaced and (6) are readily available. Conflicting reports indicate cyst formation due to inclusion of the epidermis.

To clarify his own ideas the author experimented with rabbits using thick split-skin grafts and dermis. To obtain the dermis, 65/1000 cm. grafts were taken with a dermatome and, with the graft still on the drum 30/1000 cm. of the epidermis was removed. The lumbar dorsal fascia was replaced on one side of the rabbit with a thick split-skin graft, and on the other side with a dermis graft, in one series. Burned bits of skin and buried bits of diced dermis were used in a second series. Dermis as a suture was used in a third group of rabbits. In a fourth experiment, dermis was frozen on dry ice and rapidly thawed in warm hypotonic salt solution. This procedure was repeated three times freezing the graft each time until it was boardlike.

The conclusions reached were that the burying of autogenous skin or dermis in the rabbit will result in cyst formation in from one fifth to one-third of the number done that the use of dermis alone reduces the incidence of cyst formation about one-half and that the use of treated (frozen) dermis may pre-vent cyst formation.

EARL H. KLASSEN, M.D.



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